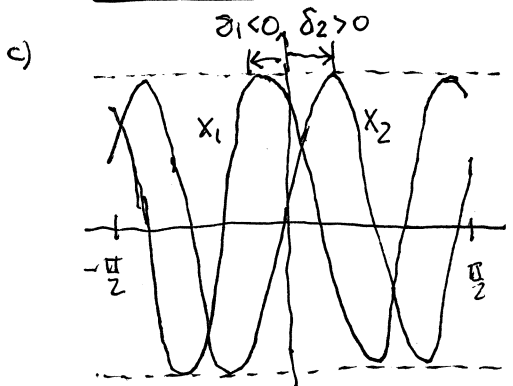


① a) $\begin{bmatrix} x_1' \\ x_2' \end{bmatrix} = \begin{bmatrix} 0 & -4 \\ 4 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} -4x_2 \\ 4x_1 \end{bmatrix} \rightarrow \boxed{x_1' = -4x_2, x_2' = 4x_1, x_1(0) = 1, x_2(0) = 2}$

b) $x_1'(t) = -4x_2(t), x_2'(t) = 4x_1(t), x_1(0) = 1, x_2(0) = 2$

$\boxed{x_1(t) = 2\sin(4t) + \cos(4t), x_2(t) = 2\cos(4t) + \sin(4t)}$

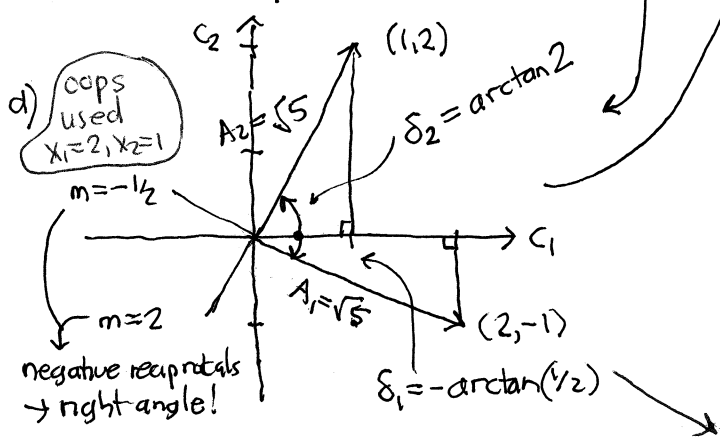
in maple worksheet soln I interchanged 1 & 2 requiring me to change handwritten soln to correct my work.



$x_1: (c_1, c_2) = (1, -2)$
 $x_2: (c_1, c_2) = (2, 1)$

c) graph shifts left a little bit since now $\delta_2 < |\delta_1|$

Note: $\sqrt{5} \approx 2.236 \rightarrow x = \pm \sqrt{5}$ envelope curves

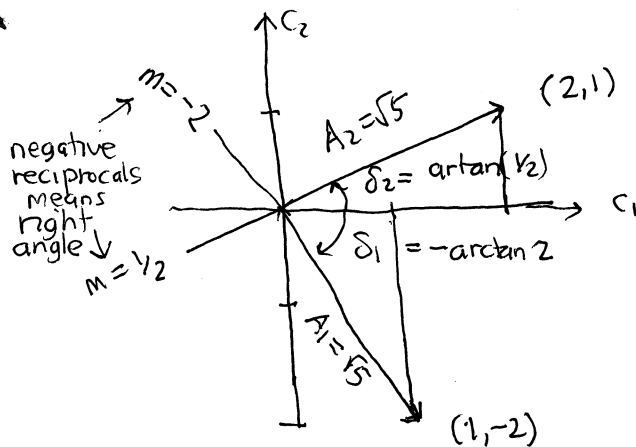


$x_1 = \sqrt{5} \cos(4t + \arctan(2))$
 $x_2 = \sqrt{5} \cos(4t - \arctan(1/2))$

$\delta_2 = \arctan(1/2) \approx 0.4636 \approx 26.6^\circ$
 $\delta_1 = -\arctan(2) \approx -1.1071 \approx -63.4^\circ$
 $\therefore 90.0^\circ$

e) $\text{polar}(2 + i), \text{polar}(1 - 2i)$

$\text{polar}(\sqrt{5}, \arctan(1/2)) \checkmark$
 $\text{polar}(\sqrt{5}, -\arctan(2)) \checkmark$



f) $\delta_2 - \delta_1 = \arctan(1/2) - (-\arctan(2))$
 $= \arctan(1/2) + \arctan(2)$
 combine
 maple $\boxed{\frac{\pi}{2}}$ 90° angle

$\frac{\delta_2 - \delta_1}{2\pi} = \frac{\frac{\pi}{2}}{2\pi} = \boxed{\frac{1}{4} \text{ cycle}}$

g) $\delta_1 < 0$ shifted left on t axis

$\delta_2 > 0$ shifted right on t axis

x_2 peaks shifted $1/4$ cycle right on t axis wrt x_1 peaks \rightarrow

x_1 peaks occur earlier in time, x_2 peaks later in time (explains what we see in plot)