# EE110B Lab 3

Name: Buddy Ugwumba SID: 862063029

## Consider the signal

$$x[n] = a^n \cos(2\pi f_o n + \phi) u[n]$$

**where $0 < a < 1$. It's D.T.F.T. is**

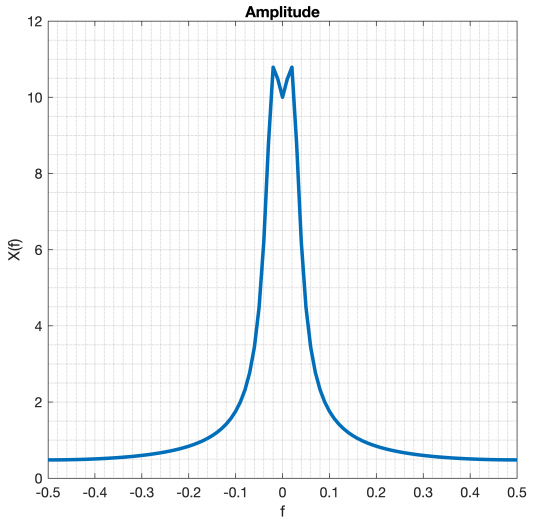
$$X(f) = \frac{0.5e^{j\Phi}}{1 - \mathrm{a}e^{\mathrm{j}2\pi f_0} e^{-\mathrm{j}2\pi f}} + \frac{0.5e^{-j\Phi}}{1 - ae^{-\mathrm{j}2\pi f_0} e^{-\mathrm{j}2\pi f}}$$
$$= \frac{\cos(\phi) - \mathrm{a}\cos(2\pi f_0 - \phi) e^{-\mathrm{j}2\pi f}}{1 - 2\mathrm{a}\cos(2\pi f_0) e^{-\mathrm{j}2\mathrm{f}} + a^2 e^{-\mathrm{j}4\pi f}}$$

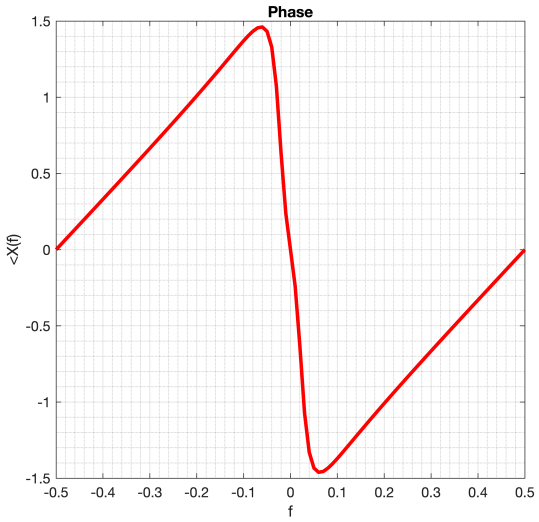
**Compute and plot the amplitude spectruen $|X(f)|$ and the phase spectrum $\angle X(f)$ over f within [-0.5, 0.5] under various choices of $f_0, a,$ and $\phi$, and discuss the effects of these parameters on the spectra. For example, you can consider the follower cases:**

**1) Choose $a = 0.9$ and $\phi = 0$ and varios values of $f_0$ within $(0, 0.5)$.**

f_0 = 0.1

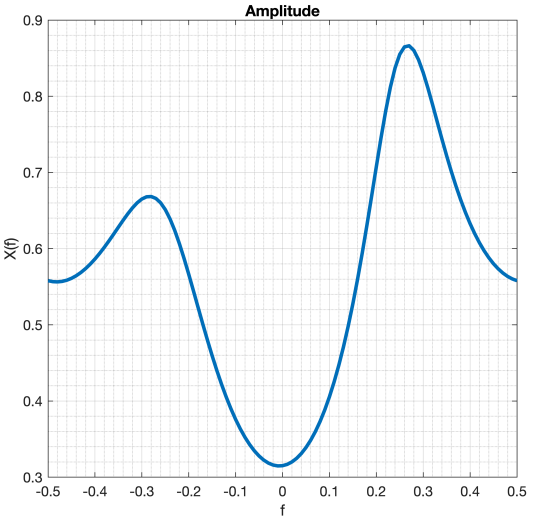
```
part1A(0.1);
```

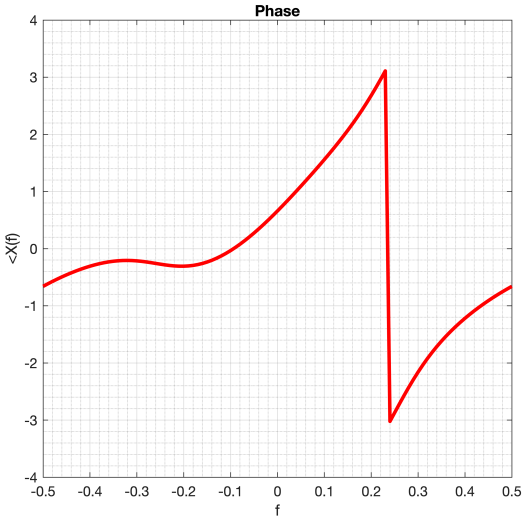



f_0 = 0.2

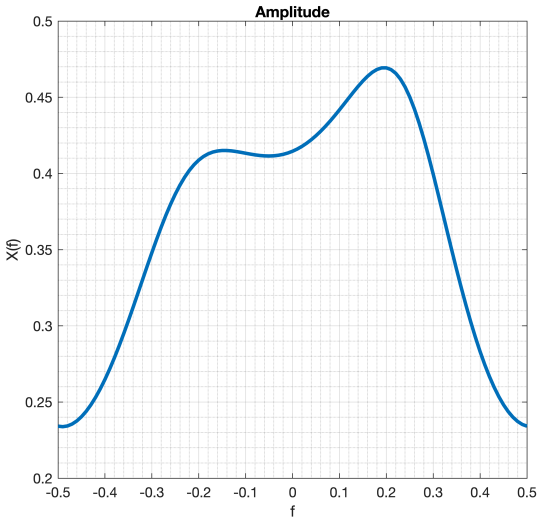
```
part1A(0.2);
```

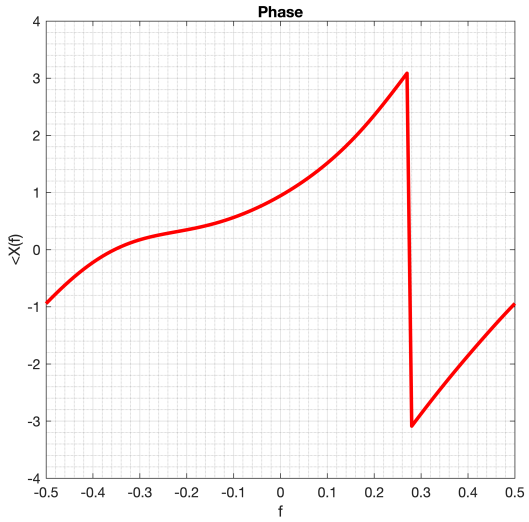



f_0 = 0.3

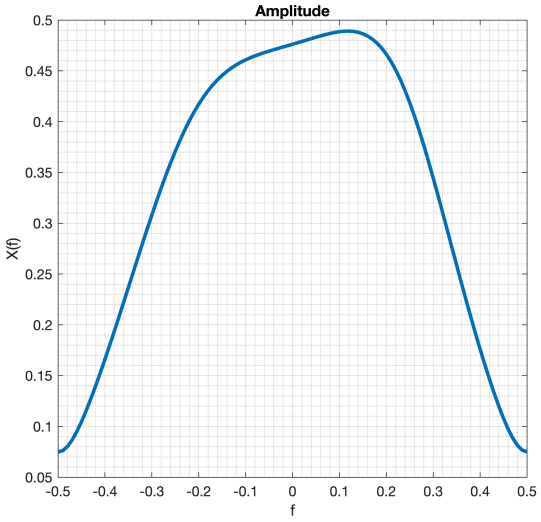
```
part1A(0.3);
```

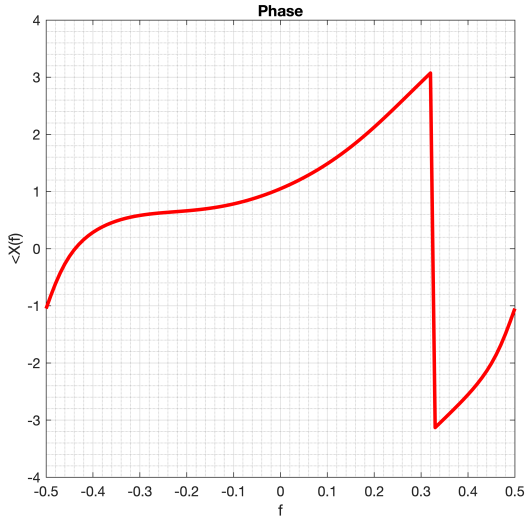



f_0 = 0.4

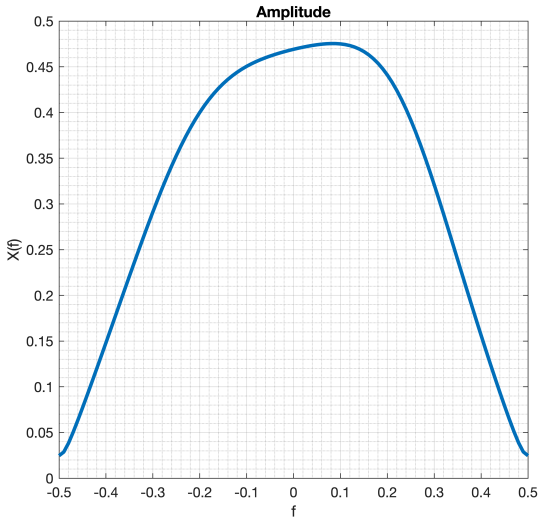
```
part1A(0.4);
```

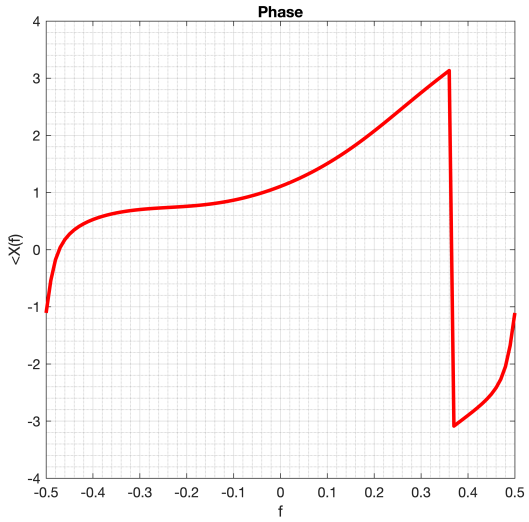



f_0 = 0.5

```
part1A(0.5);
```



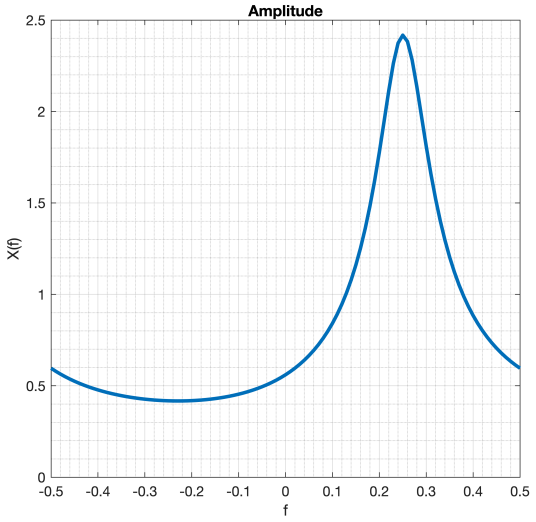



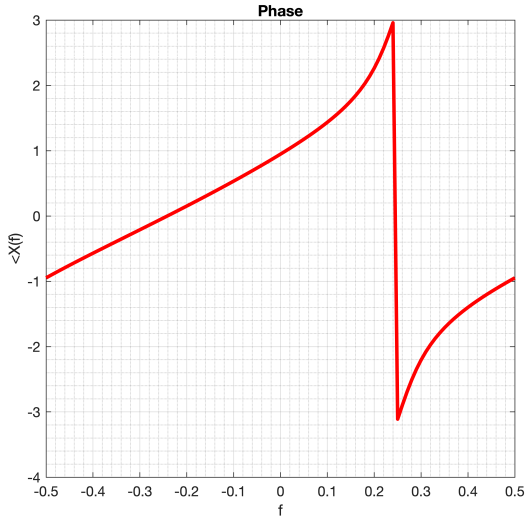

The effect of changing f_0 on the signal is as follows. The as the frequency gets closer to 1/2, the the amplitude decreases and the phase shifts to the right; a horizontal phase shift away from the origin.

**2) Choose $f_0 = 0.2$ and $\phi = 0$ and various values of $a$ within $(0, 1)$.**

a = 0.1

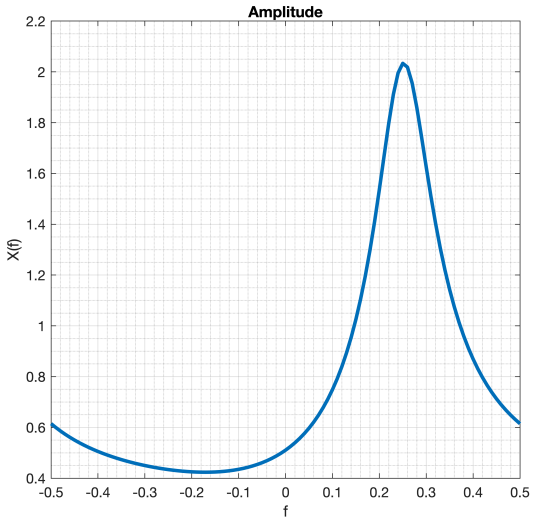
```
part1B(0.1);
```

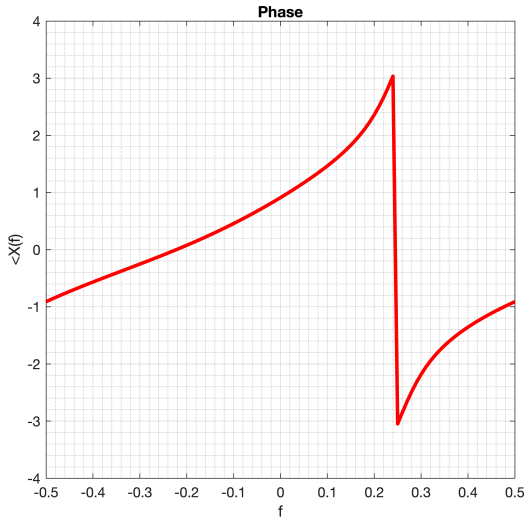



a = 0.3

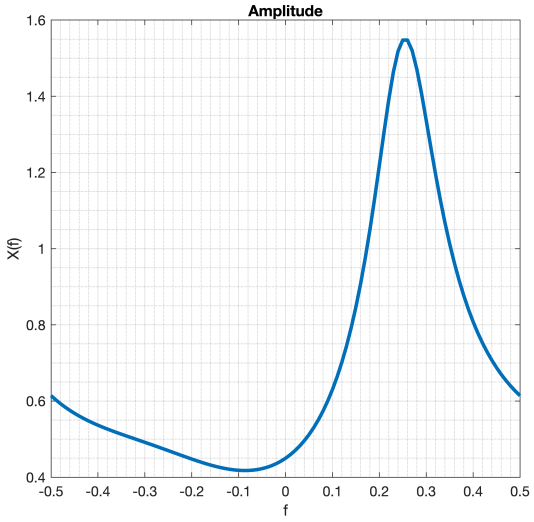
```
part1B(0.3);
```

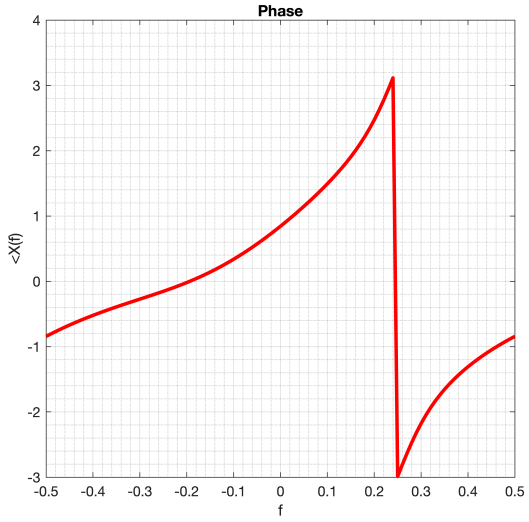



a = 0.5

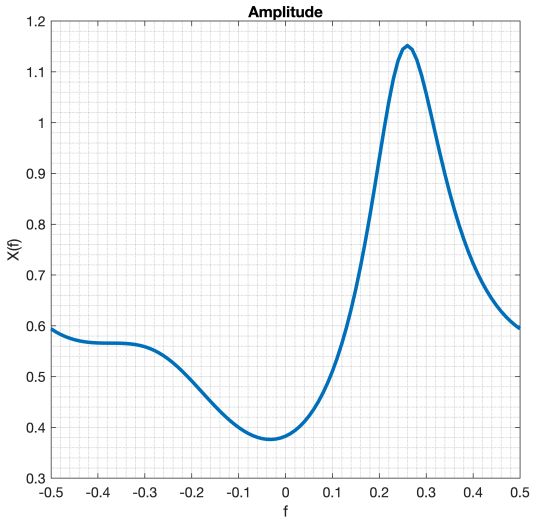
```
part1B(0.5);
```

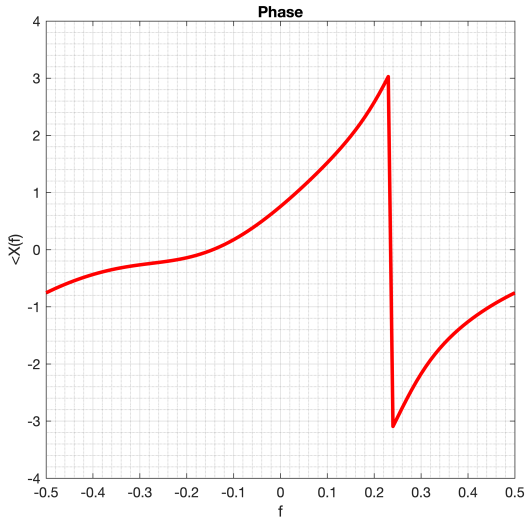



a = 0.7

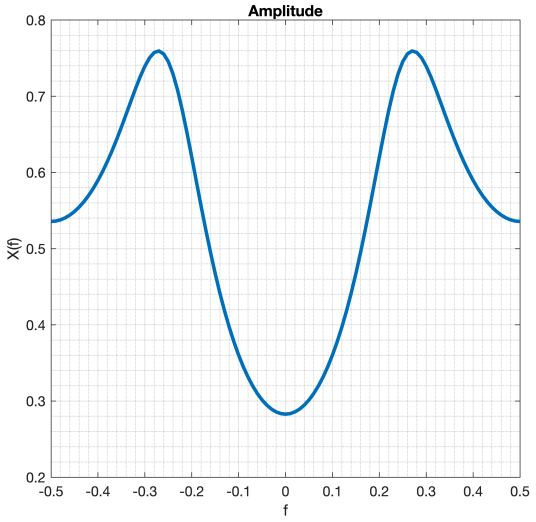
```
part1B(0.7);
```

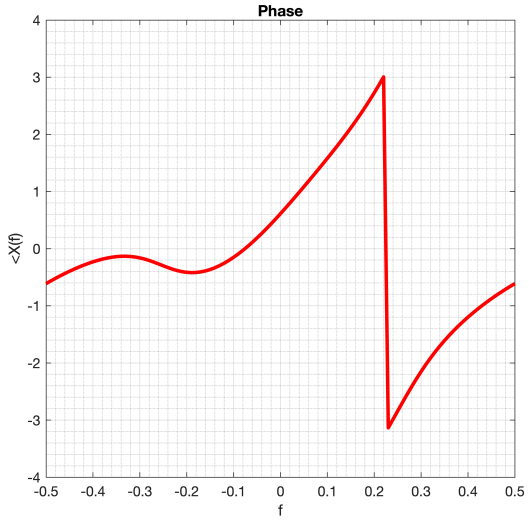



a = 1

```
part1B(1);
```



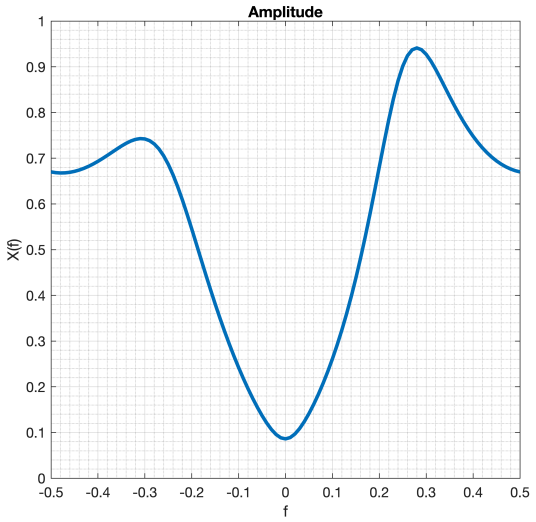



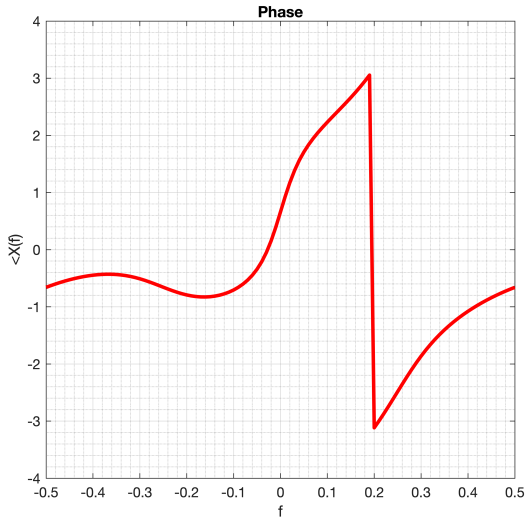

the effect of changing a is the following: The signals minema and maxima increase in magnitude. This change cause a discontinutiy in the phase. You see less linearity as a approaches 1

**3) Choose $f_0 = 0.2$ and $a = 0.9$ and varios values of $\phi$ within $(0, \pi)$.**

$\phi = \frac{\pi}{6}$

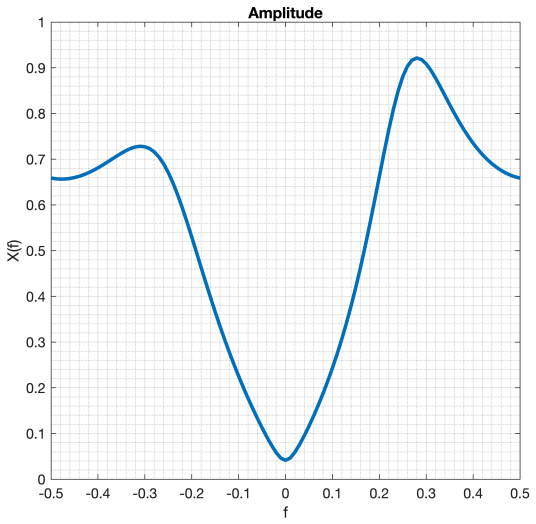
```
part1C(pi/6);
```

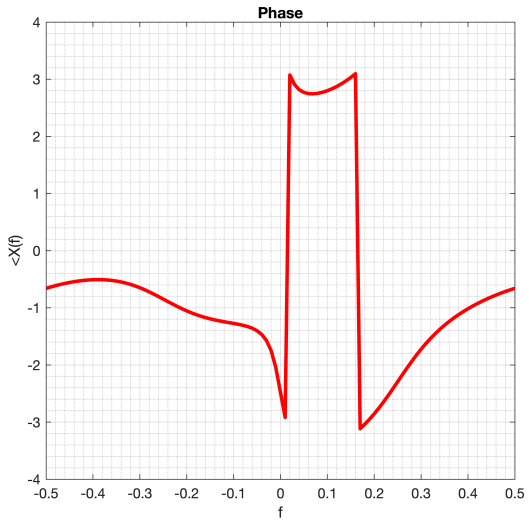



$\phi = \frac{\pi}{4}$

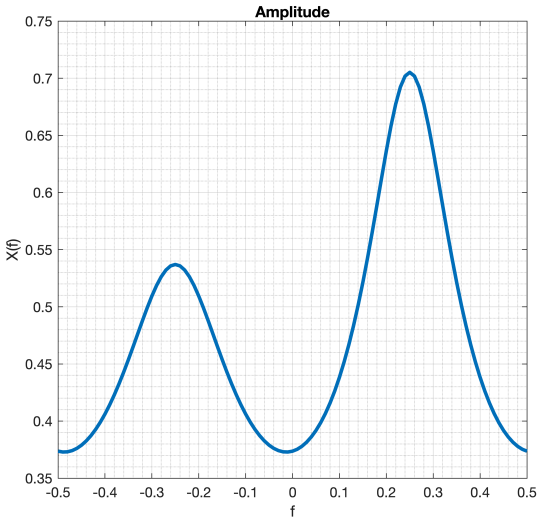
```
part1C(pi/4);
```

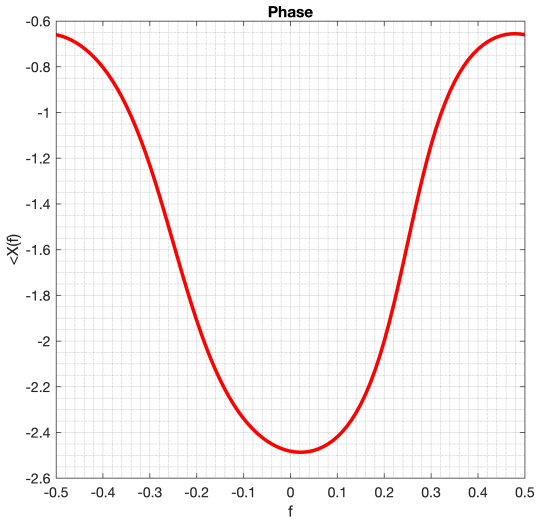



$\phi = \frac{\pi}{2}$

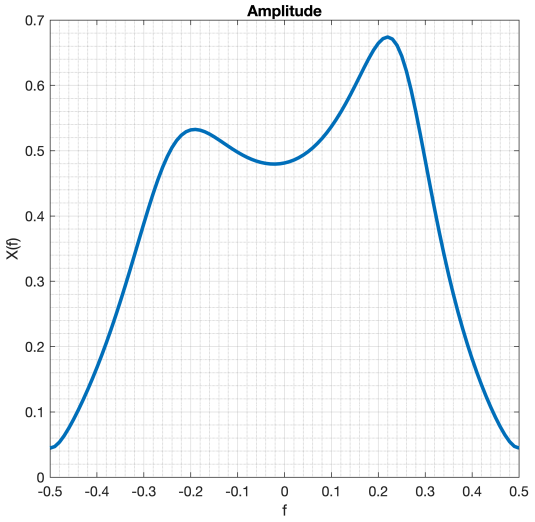
```
part1C(pi/2);
```

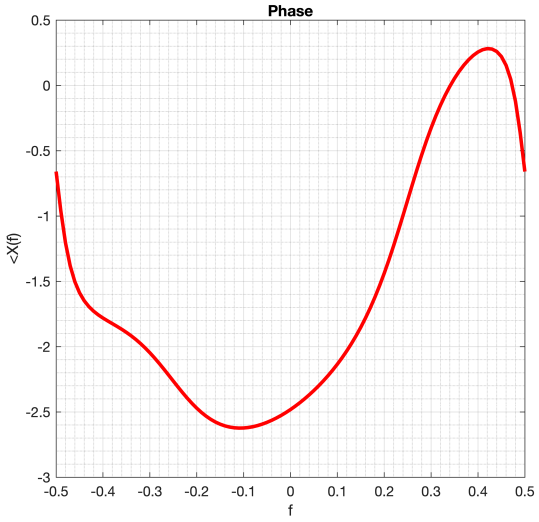



$$\phi = \frac{2\pi}{3}$$

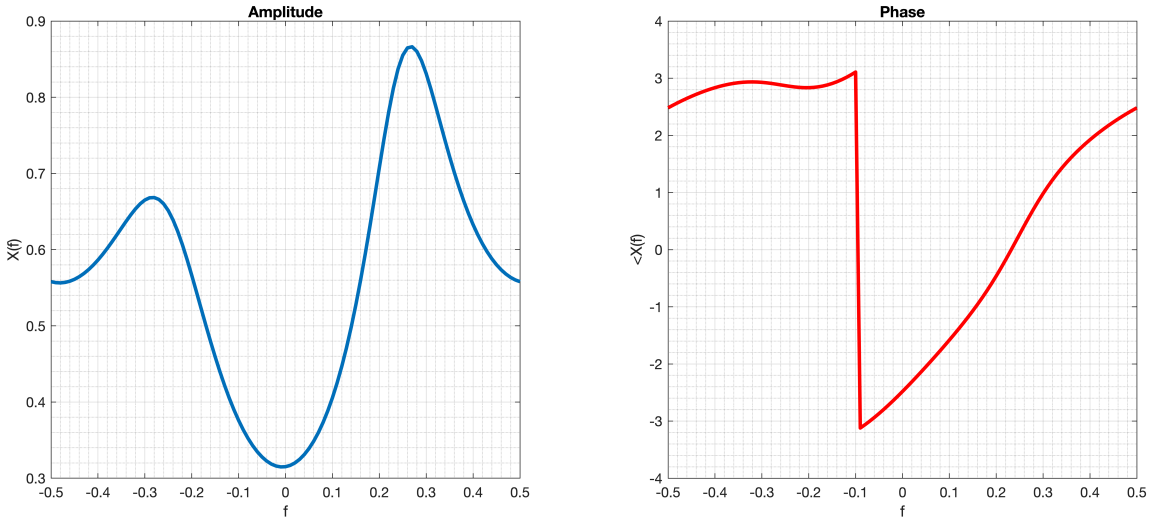
```
part1C((2*pi)/3);
```




$$\phi = \pi$$

```
part1C(pi);
```




the effect of chaniging $\phi$ is a reduction in the amplitude and a reverse shift in the polarity of the phase. As the phase gets close to the pi/2 the polarity becomes increasingly negative and then corrects itself the close that phi gets to pi.