1. Find and sketch the magnitudes $|X(f)|$ and phases $\angle X(f)$ of the Fourier transforms of the signals (a-f) below. (10 points each)

(a) $x(t) = \text{rect}(t-2)$

(b) $x(t) = 5\text{sinc}(2(t - 1))$

(c) $x(t) = 3\delta(3t - 9)$

(d) $x(t) = 10\cos(400\pi t)$

(e) $x(t) = \frac{10}{3+j2\pi t} - \frac{4}{5+j2\pi t}$

(f) $x(t) = 2\text{rect}(t)\cos(20\pi t)$

Note: You can use a computer (e.g., MATLAB) to generate the plots, but you must find and use the mathematical expressions for the quantities above to generate your plots.

2. If the signal $x(t)$ given below has Fourier transform $X(f) = \frac{1}{(2\pi f)^2} (e^{-j2\pi f} + j2\pi f e^{-j2\pi f} - 1)$, find the Fourier transform of the signals (a) and (b) below. (10 points each)

(a)

(b)

3. If $x(t) = \text{sinc}(t - 2)$ and $h(t) = \text{sinc}(3t + 3)$, find $y(t) = x(t) * h(t)$. (10 points)

4. Show that if $X(f)$ is the Fourier transform of $x(t)$, then the total net area under the curve $x(t)$ given by $\int_{-\infty}^{\infty} x(t)dt = X(0)$. Additionally, show that the total net area under the curve $X(f)$ is given by $\int_{-\infty}^{\infty} X(f)df = x(0)$. (10 points)

Notation: $\text{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$; $\text{rect}(t) = 1$ if $|t| \leq 1/2$, and $\text{rect}(t) = 0$ otherwise.