HW#6 Numerical Integration

#1 Root Mean Square

(a) Find the rms value of $\sin\omega t \ \ (\omega=1,2,3\,rad/sec)$ by numerical integration methods.
and also by using trigonometric identities.
(see http://numericalmethods.eng.usf.edu/ for numerical integration)

(b) Explain the relationship between the following rms values.

$$\sqrt{\frac{x^2[0]+x^2[1]+\cdots+x^2[n-1]}{n}}$$

$$\sqrt{\frac{1}{T_2-T_1}\int_{T_1}^{T_2}x^2(t)\,dt}$$

#2 Computing Fourier Series Coefficients

(a) find the fundamental period of $\sin\omega t \ \ (\omega=2\,rad/sec)$.

(b) find the integration values over the fundamental period
$sin2t\,sin2t$
$sin2t\,sin4t$
$sin2t\,cos2t$
$sin2t\,cos4t$
by numerical integration methods and also by trigonometric relationships.

(c) find the Fourier coefficients of $f(t)=sin2t+0.3\,sin4t-0.9\,cos6t$ and plot the result.

(see http://www.complextoreal.com/chapters/fft1.pdf)

#3 Find the maximum

Assume a complex constant z_1 has the value of $\cos\frac{\pi}{4}+j\sin\frac{\pi}{4}=e^{j\frac{\pi}{4}}$.

Consider the function $f(z)=\frac{z_1 z}{|z_1||z|}$.

Plot the function and find the maximum

#4 Cauchy-Schwartz Inequality

$x_1,\cdots,x_n\in\boldsymbol{C}$ $\quad$ $y_1,\cdots,y_n\in\boldsymbol{C}$ are any complex numbers

Then Cauchy-Schwartz inequality is as follows.

$$|x_1\bar{y}_1+\cdots+x_n\bar{y}_n|^2=(|x_1|^2+\cdots+|x_n|^2)(|y_1|^2+\cdots+|y_n|^2)$$

Explain this formula in relation to #3 problem.