ELEC 421 - Assignment #2

1. Show that

$(a) \quad \delta(n) = u(n) - u(n-1)$

$(b) \quad u(n) = \sum_{k=-\infty}^{n} \delta(k) = \sum_{k=-\infty}^{n} \delta(n-k)$

2. (a) If *y(n) = x(n)*h(n),* show that $\Sigma_y = \Sigma_x \Sigma_h$, where

$$\sum_{x} = \sum_{n=-\infty}^{\infty} x(n)$$

(b) Compute the convolution *y(n) = x(n)*h(n)* of the following signals and check correctness of the results by using the test in (a). *(bold indicates 0 location)*

1. *x(n) = {**1**,2,4}, h(n) = {**1**,1,1,1,1}*
2. *x(n) = {**1**,2,-1}, h(n) = x(n)*
3. *x(n) = {**0**,1,-2,3,-4}, h(n) = {**1/2**,1/2,1,1/2}*
4. *x(n) = {**1**,2,3,4,5}, h(n) = {**1**}*
5. *x(n) = {**1**,-2,3}, h(n) = {**0**,0,1,1,1,1}*

3. Determine (both graphically and analytically) the convolution y(n) of the signals

$$x(n) = \begin{cases} \frac{1}{3}n & 0 \le n \le 6 \\ 0 & elsewhere \end{cases}$$

$$x(n) = \begin{cases} 1 & -2 \le n \le 2 \\ 0 & elsewhere \end{cases}$$

4. A digital communication link carries binary-coded words representing samples of an input signal

$$x_\omega(t) = 3\cos 600\pi t + 2\cos 1800\,\pi t$$

The link is operated at 10,000 bits/s and each input sample is quantized into 102 different voltage levels (10 bits).

(a) What is the sampling frequency and Fmax for this signal?
(b) What is the Nyquist rate for the signal $x_\omega\ (t)$?
(c) What are the frequencies in the resulting x(n) signal?