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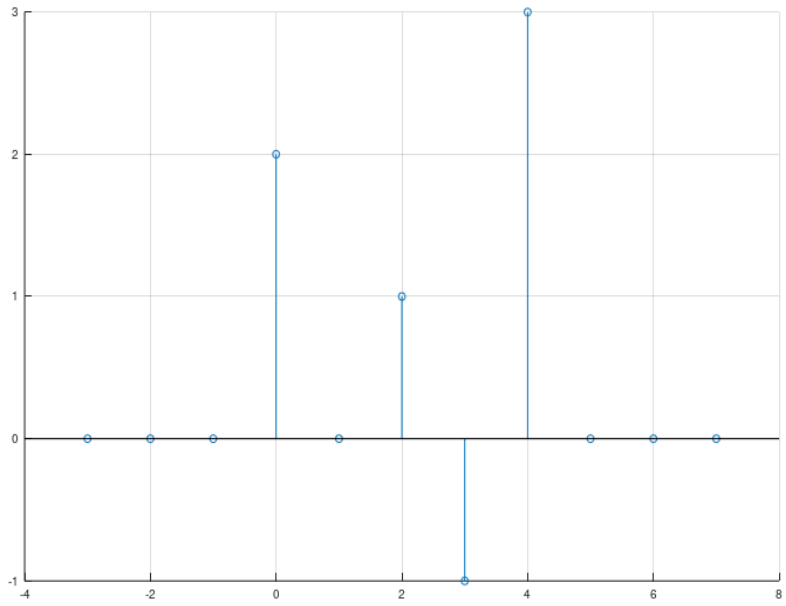
Experiment 2 Results sheet:

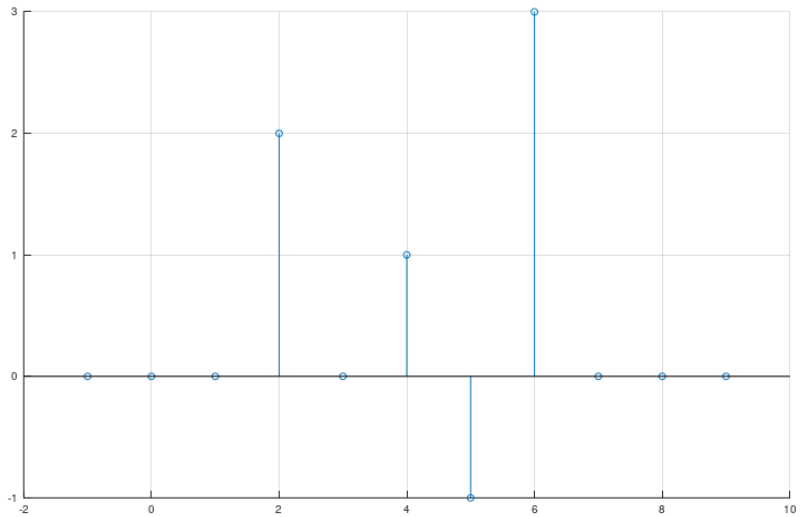
1- a) Code and plot for x[n]

```
nx = [-3:7];
x = [0 0 0 2 0 1 -1 3 0 0 0];
stem(nx, x);
```

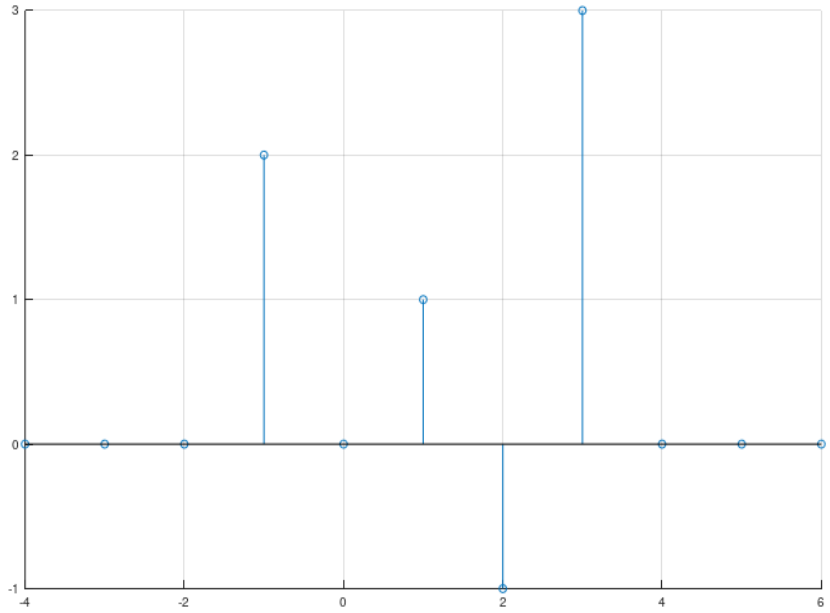


b) Write the definition of the new axis and plot the signal in the table below:

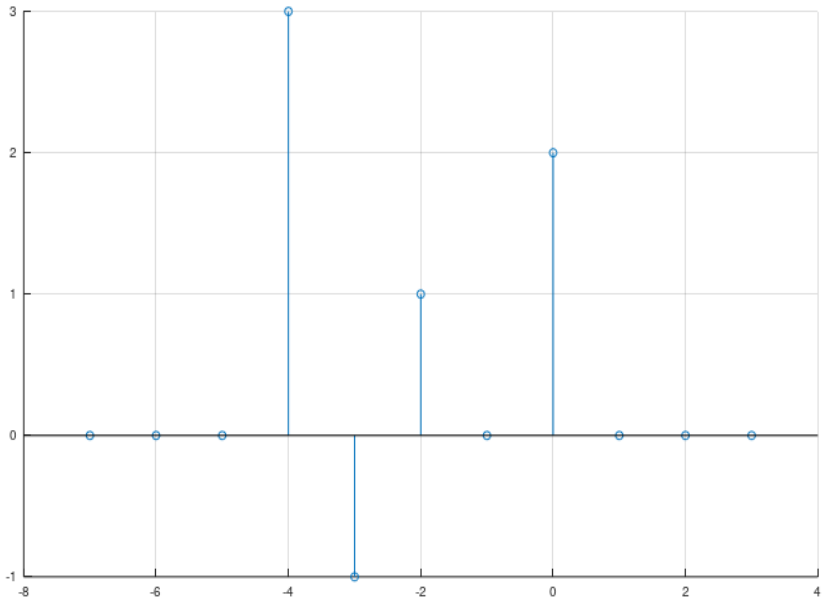
```
nx = [-3,7];
x = [0 0 0 2 0 1 -1 3 0 0 0];
#for y1
ny1 = nx + 2;
stem(ny1, x);
```



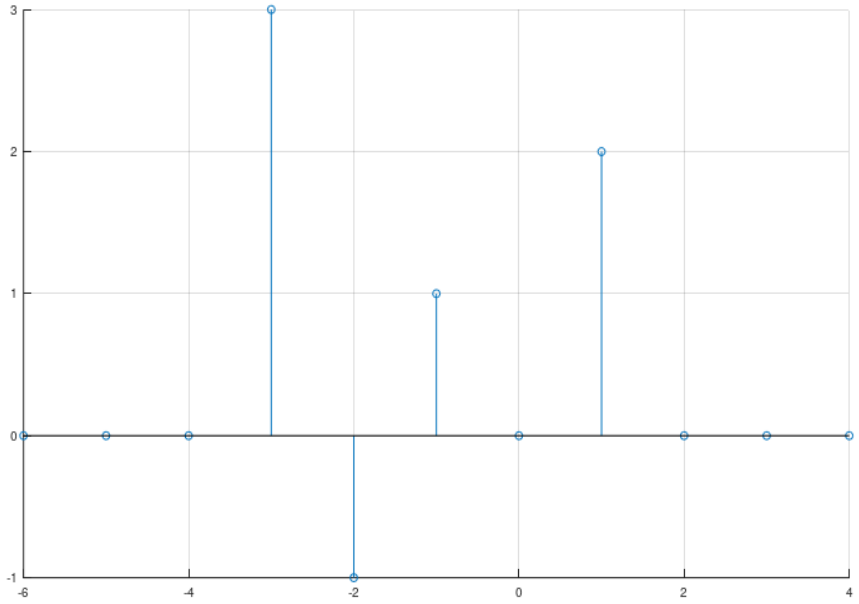
```
nx = [-3,7];
x = [0 0 0 2 0 1 -1 3 0 0 0];
#for y2
ny2 = nx - 1;
stem(ny2, x);
```




```
nx = [-3,7];
x = [0 0 0 2 0 1 -1 3 0 0 0];
#for y3
ny3 = -1 * nx;
stem(ny3, x);
```



```
nx = [-3,7];
x = [0 0 0 2 0 1 -1 3 0 0 0];
#for y4
ny4 = -1 * (nx - 1);
stem(ny4, x);
```

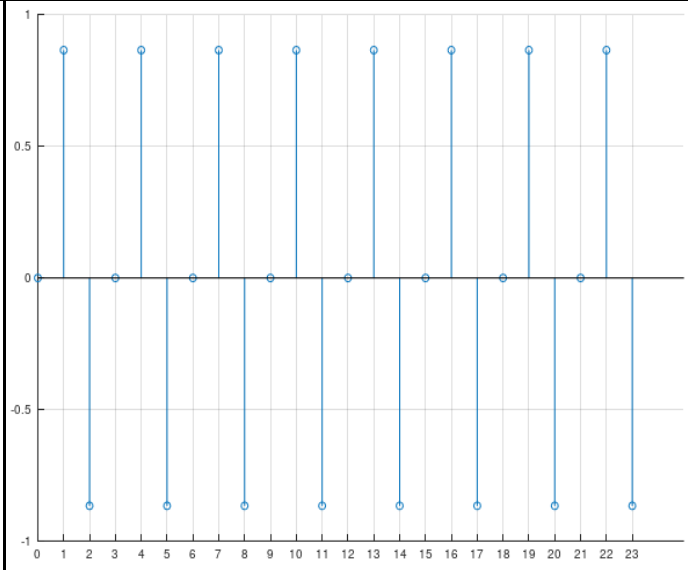
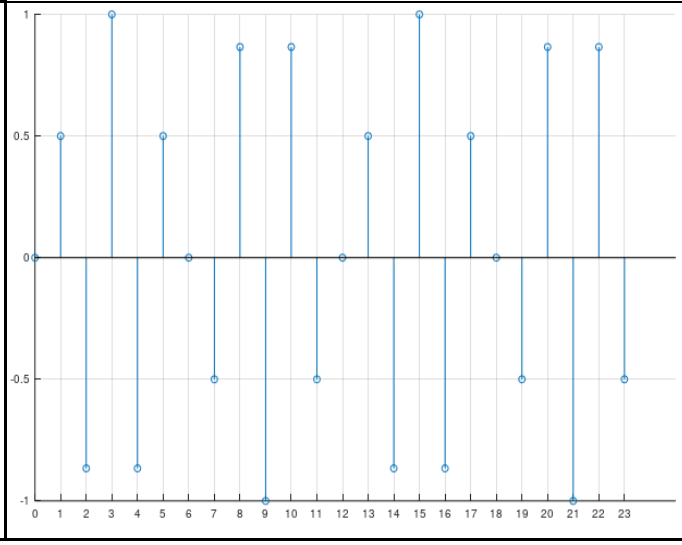


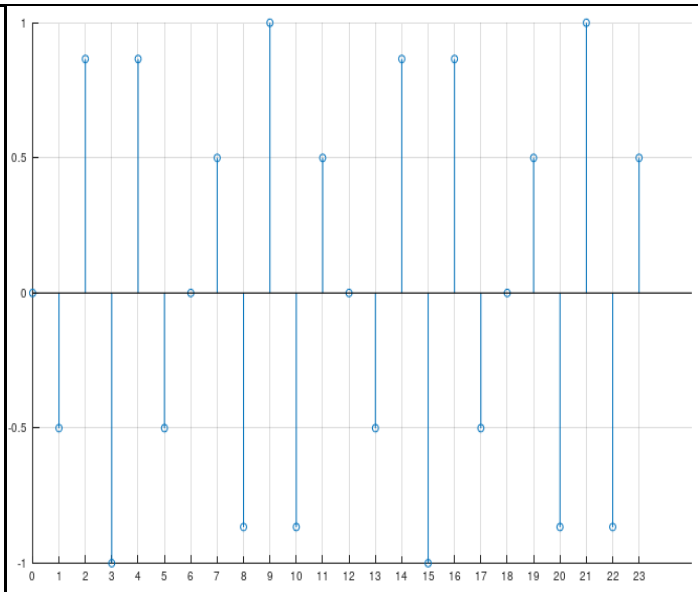
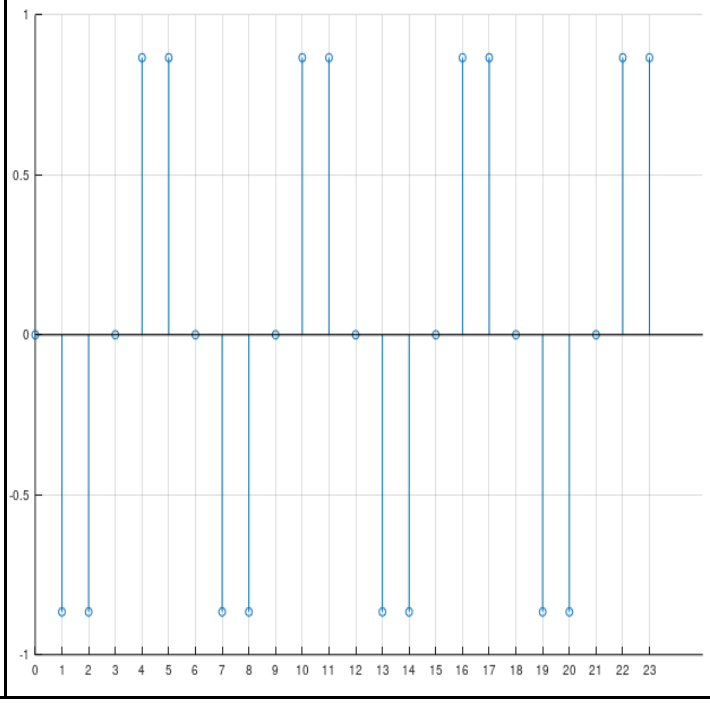
2- a)

The fundamental period can be calculated from the ratio (M / N), it is equivalent to the denominator of this ratio (after simplification). It can be also determined by calculating the greatest common divisor (GCD) of M and N by using the formula: $T_0 = N / GCD(M, N)$.

The code that is used for plotting:

```
M = 4;   #change the value of M at each plot
N = 12;
n = [0:2 * N - 1];
x = sin(2 * pi * M * n / N);
stem(n, x);
xticks(0:2 * N -1);
```

M	Plotting	Fundamental period
4		The fundamental period is: 3 (from the graph). (M / N = 4 / 12 = 1 / 3).
5		The fundamental period is: 12 (from the graph). (M / N = 5 / 12).

7		The fundamental period is: 12 (from the graph). (M / N = 7 / 12)
10		The fundamental period is: 6 (from the graph). (M / N = 10 / 12 = 5 / 6)

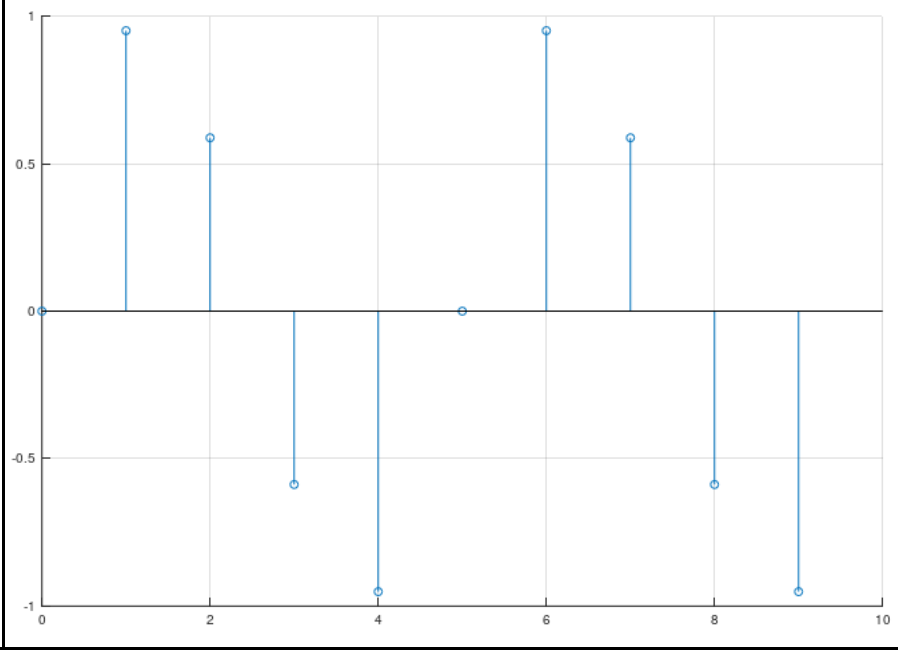
2- b)

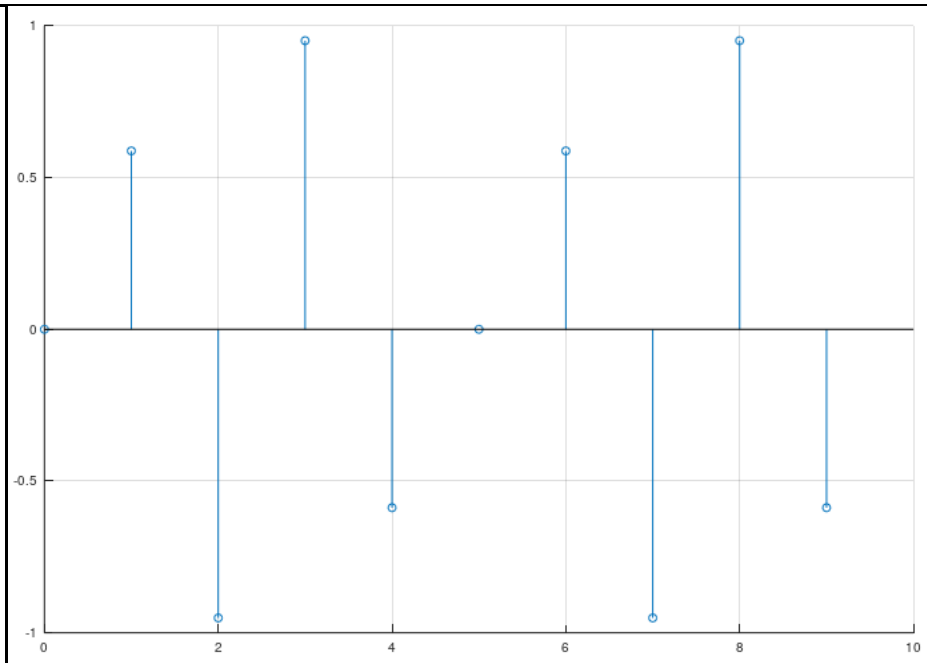
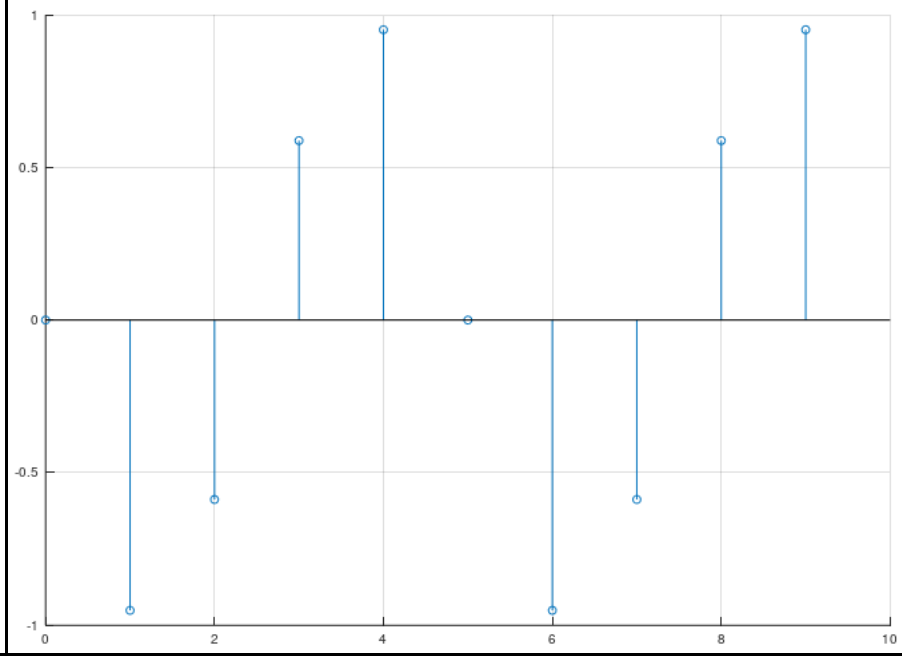
There are three unique plotted signals. For k = 1 and k = 6, the two signals are the same.

The fundamental period of the signal is 5 (since all the values of k are not divisible by 5),
x[n] = x[n + N] ➔ x[1] = x[1+5] = x[6]

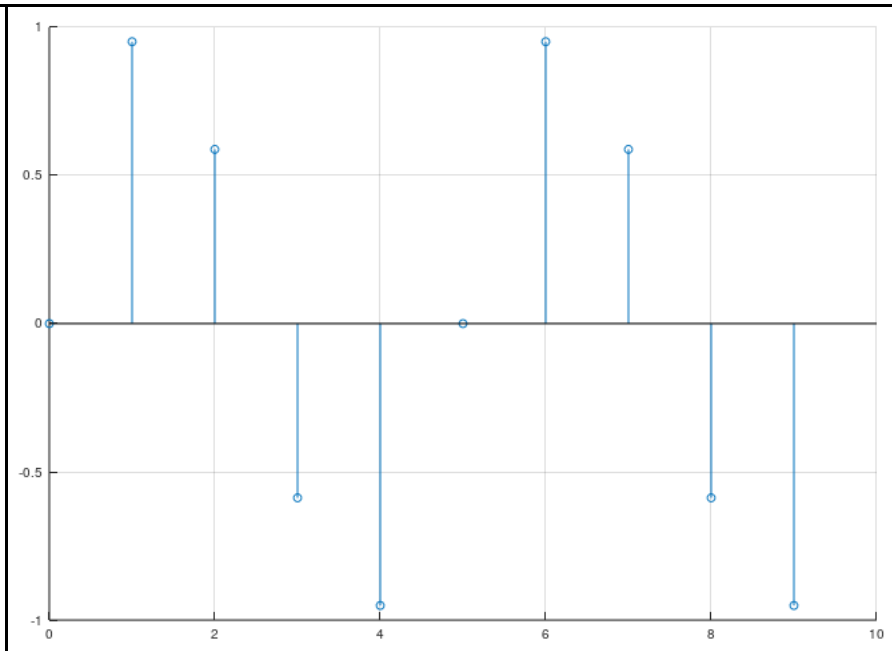
The code for plotting the signal Xk[n]:

```
k = 1;     # change the value of k at each plot
n = [0:9];
w = 2 * pi / 5;
x = sin(w * k * n);
stem(n, x);
```

K	Stem of x
1	

2	 1 0.5 0 -0.5 -1 0 2 4 6 8 10
4	 1 0.5 0 -0.5 -1 0 2 4 6 8 10

6



3)

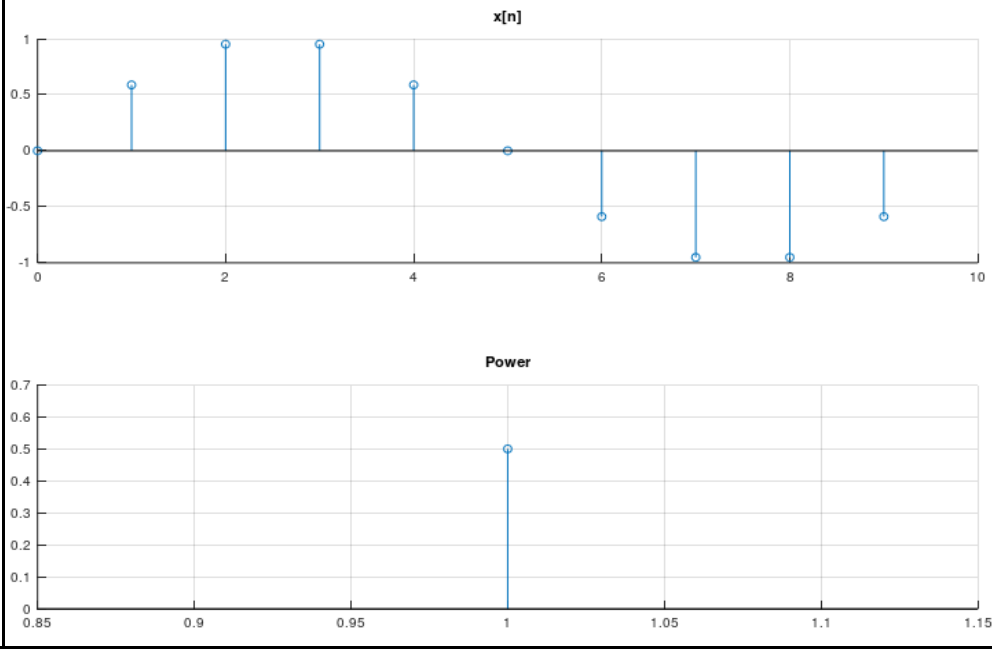
a

```
N = 10;
M = 1;
n = [0:N-1];
x = sin(2 * pi * n * M / N);
subplot(2, 1, 1);
stem(n, x);
title("x[n]");

E_total = sum(x.^2);
P_total = E_total / length(x);
disp("E_total:");
disp(E_total);
disp("P_total:");
disp(P_total);
subplot(2, 1, 2);
stem(P_total);
title("Power");
```

Program Output:

```
E_total:
 5.0000
P_total:
 0.50000
```



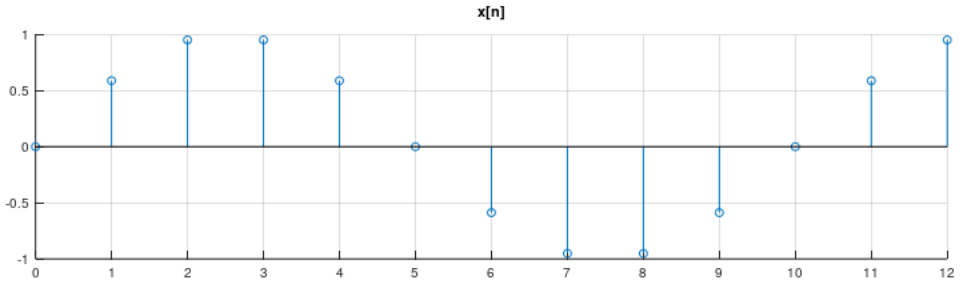
b

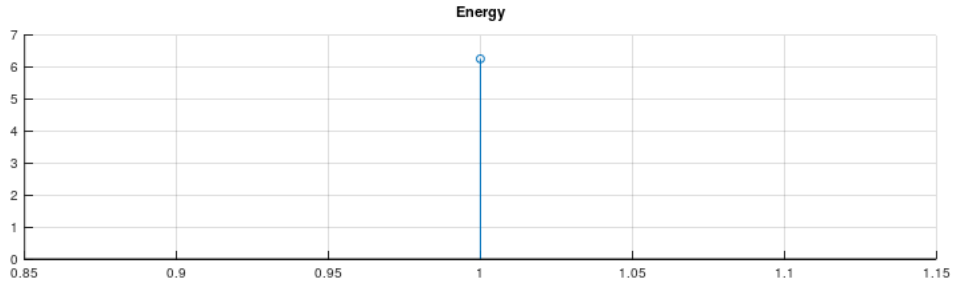
```
N = 10;
M = 1;
n = [0:12];
x = sin(2 * pi * n * M / N);
subplot(2, 1, 1);
stem(n, x);
title("x[n]");
xticks(0:12);

E_total = sum(x.^2);
disp("E_total:");
disp(E_total);
subplot(2, 1, 2);
stem(E_total);
title("Energy");
```

Program Output:

```
E_total:
  6.2500
```





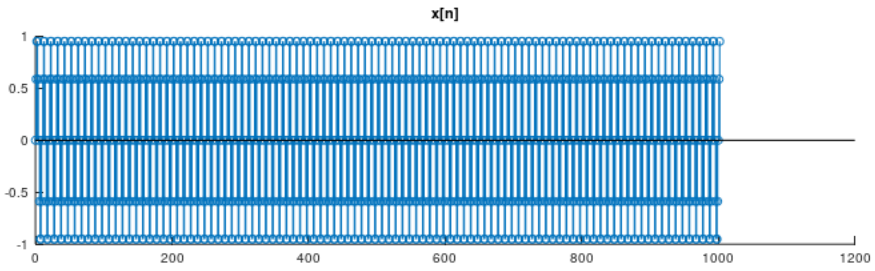
c

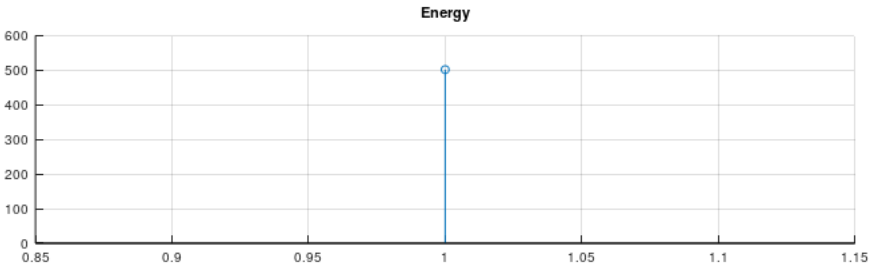
```
N = 10;
M = 1;
n = [0:1002];
x = sin(2 * pi * n * M / N);
subplot(2, 1, 1);
stem(n, x);
title("x[n]");

E_total = sum(x.^2);
disp("E_total:");
disp(E_total);
subplot(2, 1, 2);
stem(E_total);
title("Energy");
```

Program Output:

```
E_total:
 501.25
```





Comments:

The power of the signals (b) and (c) is zero because the two signals are aperiodic.

The energy of the signal increases as the number of samples increases.