LAB SHEET 01

NAME : MADHU SAI NAIK P

ROLL NO : EE23B039

DISCRETE TIME SINUSOIDS AND EXPONENTIONALS.

A. Properties of sinusoids

1. Frequencies seprated by 2pi.

1 Fx a value of A.

```
A = 7;
```

2 Randomly generate a value of w_0 and phi of w_0 belongs to 0 to 2pi and phi belongs to -pi to pi

```
w = rand * 2*pi
```

```
w = 5.1191
```

```
phi = -pi + 2*pi * rand
```

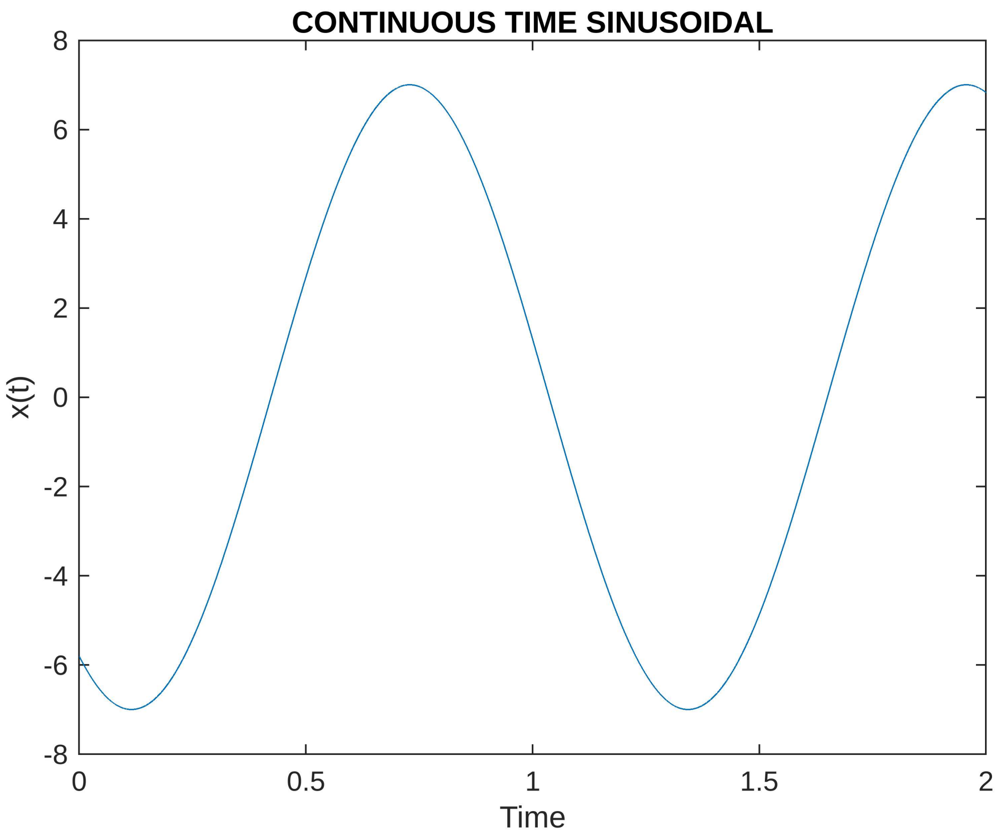
```
phi = 2.5497
```

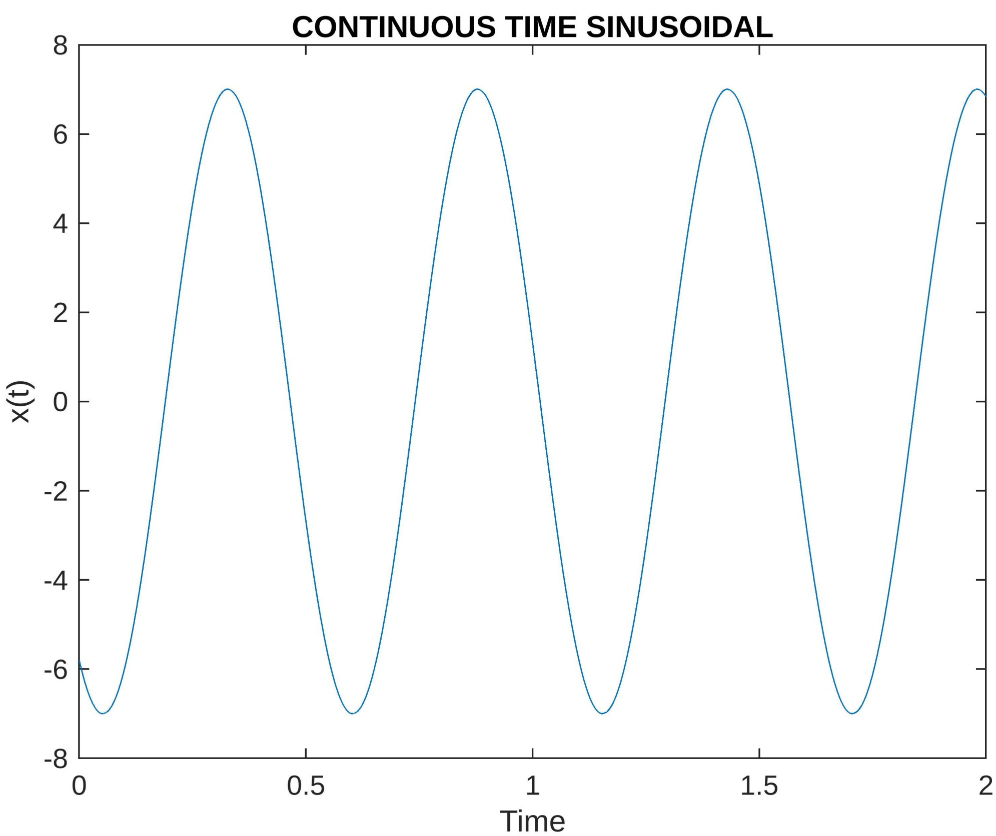
3 Sketch the followuing sinusoids : x(t) = Acos((w_0 + 2*pi*k)t+phi) for k = 0,1,2,3,4.

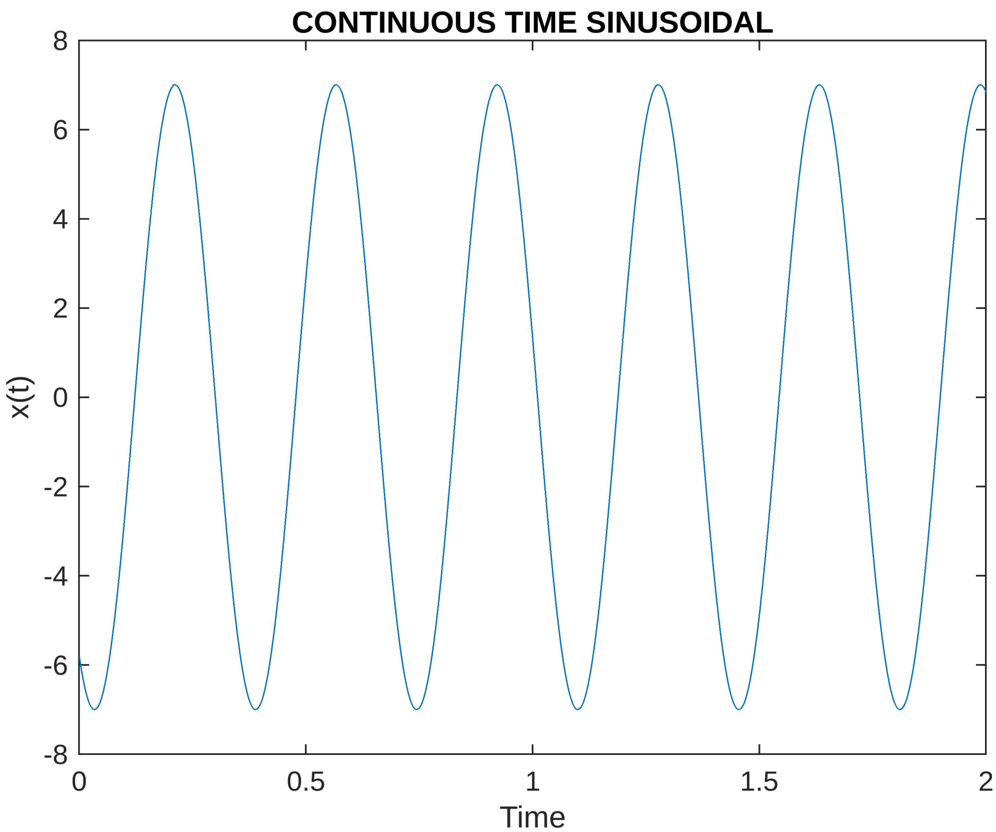
```
disp("Continuous Time Sinusoidal");
```

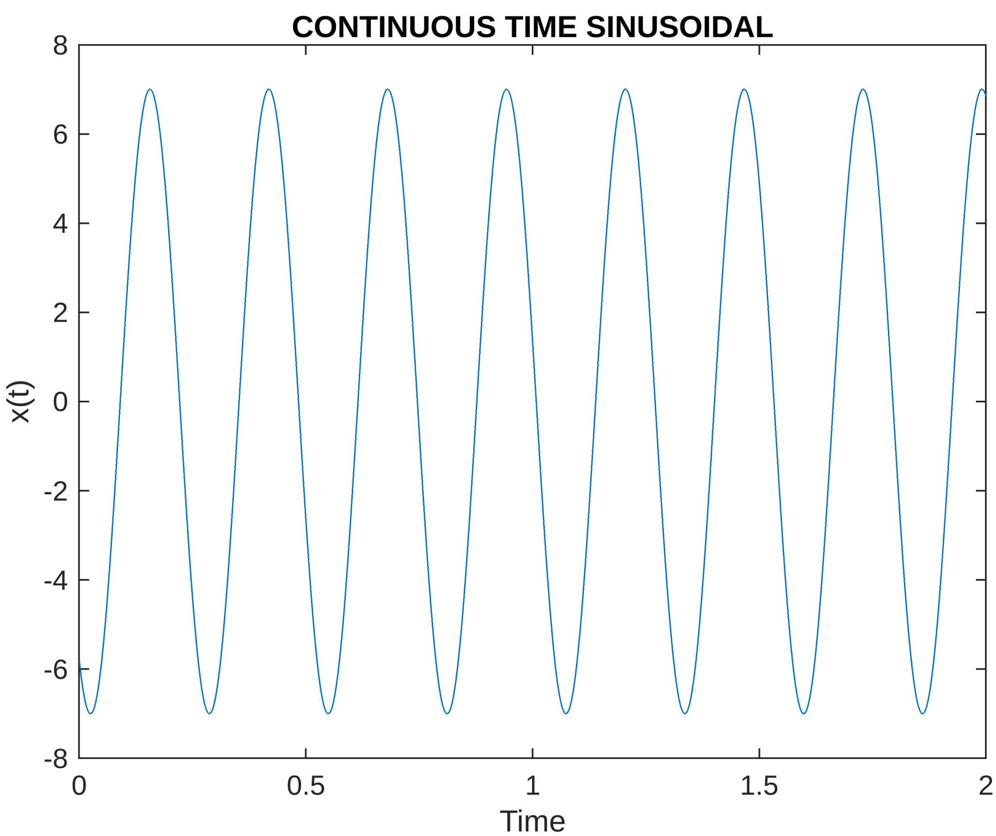
```
Continuous Time Sinusoidal
```

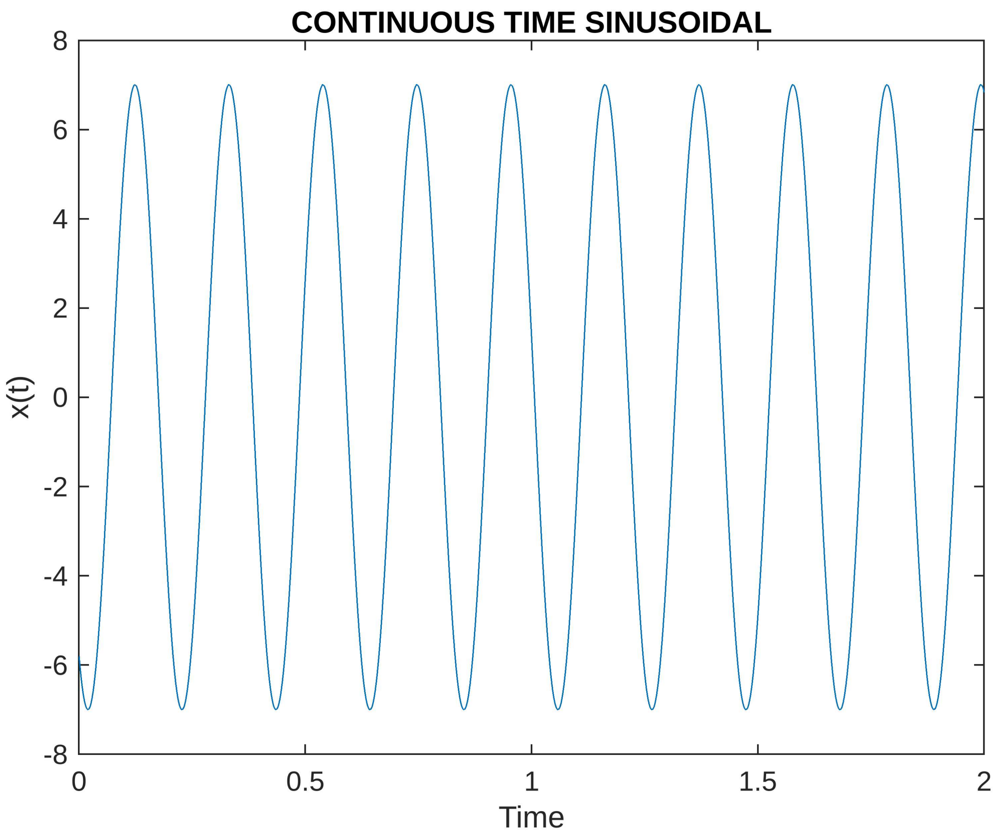
```
for k = 0:4
    t = 0:0.0001:2;
    x_t = A*cos((w+2*pi*k)*t+phi);
    figure;
    plot(t,x_t);
    xlabel('Time');
    ylabel('x(t)');
    title('CONTINUOUS TIME SINUSOIDAL');
end
```


CONTINUOUS TIME SINUSOIDAL
8
6
4
2
0
-2
-4
-6
-8
x(t)
0
0.5
1
1.5
2
Time


CONTINUOUS TIME SINUSOIDAL
8
6
4
2
0
-2
-4
-6
-8
x(t)
0
0.5
1
1.5
2
Time


CONTINUOUS TIME SINUSOIDAL
x(t)
Time
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2


CONTINUOUS TIME SINUSOIDAL
x(t)
Time
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2

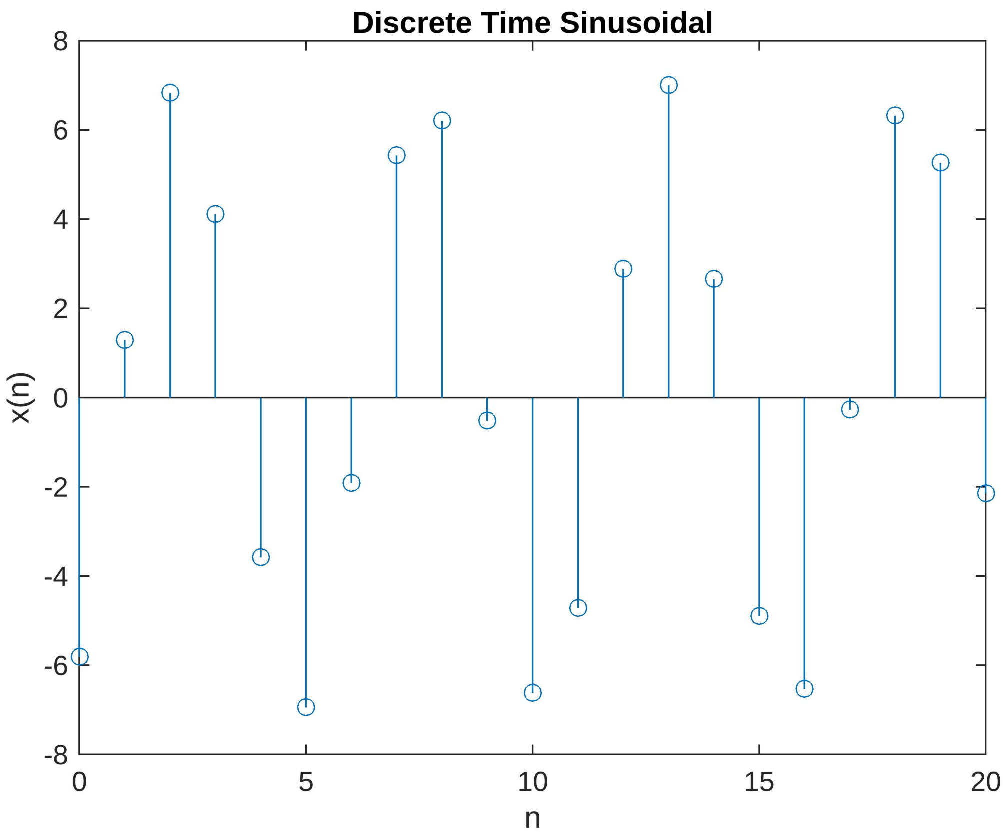


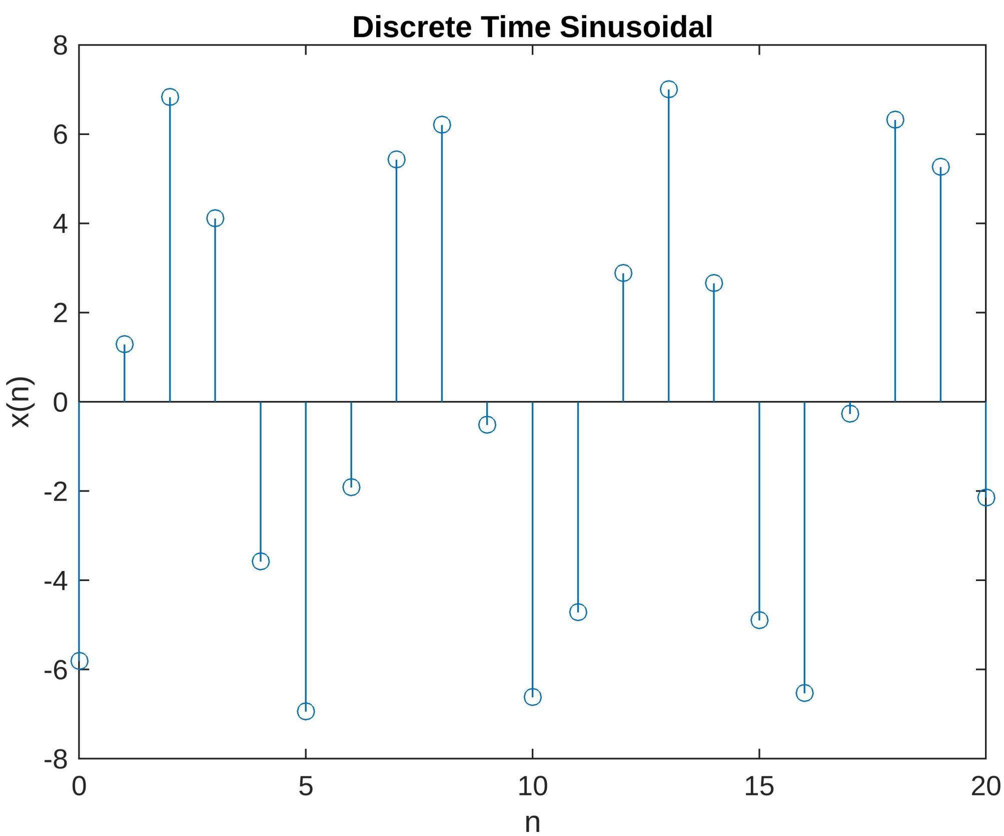
4 Similarly sketching x(t) in discrete time sinusoids.

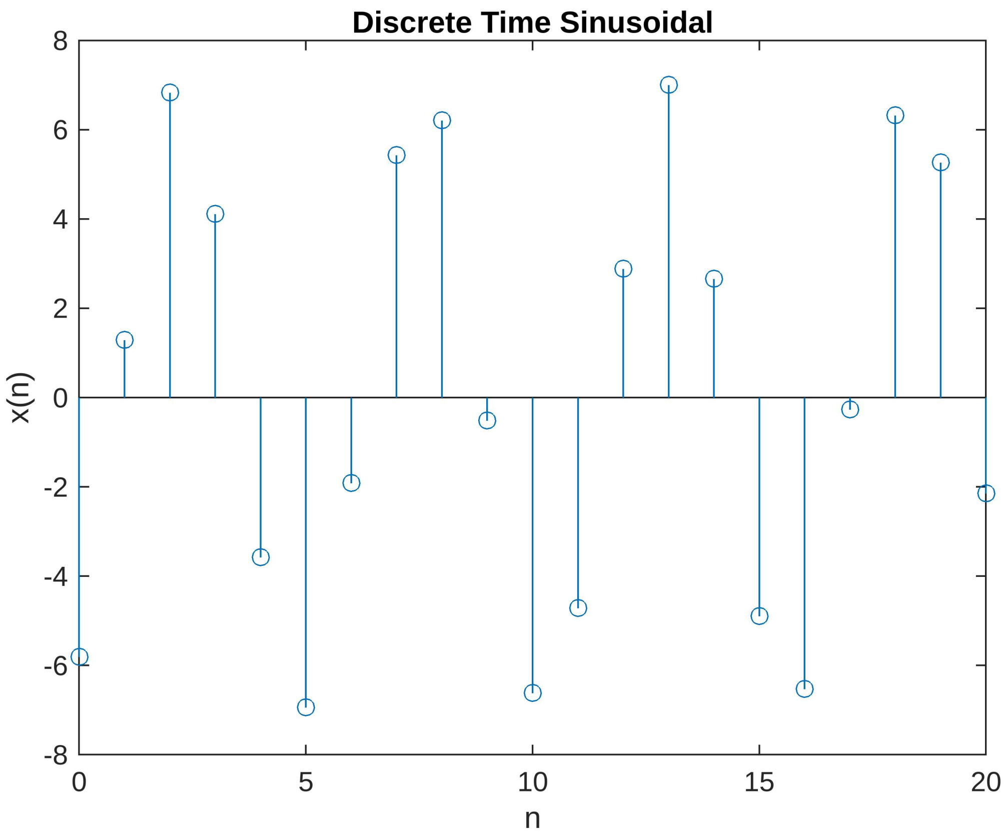
```
disp("Discrete Time Sinusoidal")
```

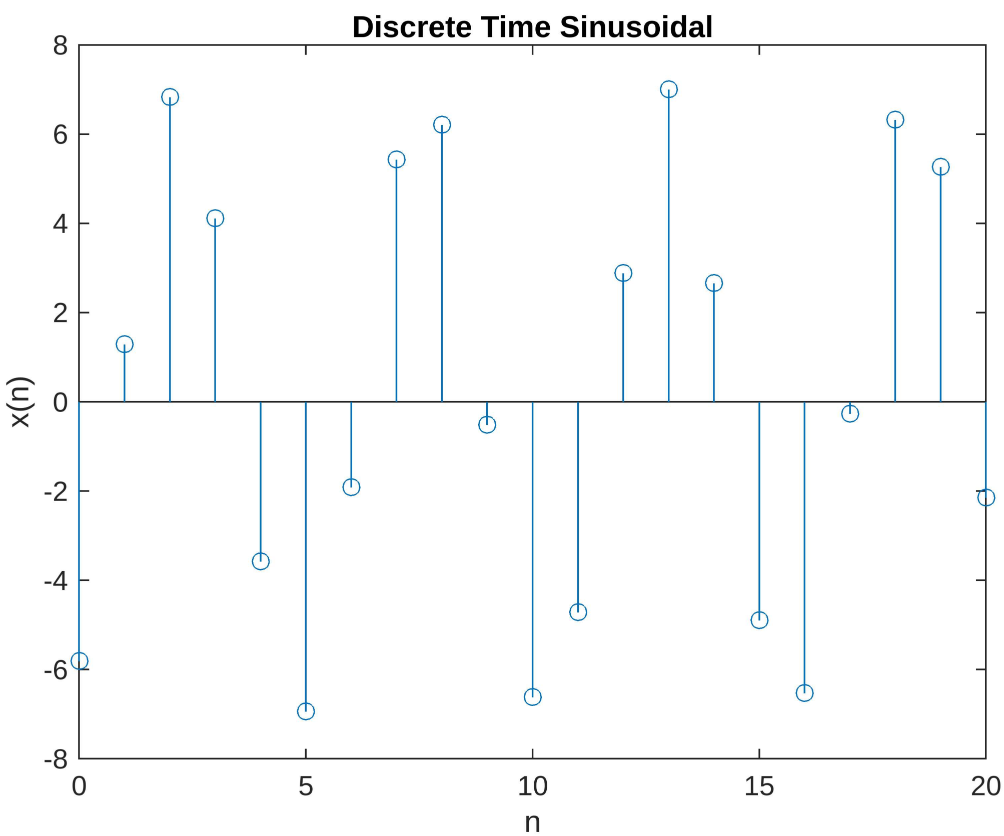
```
Discrete Time Sinusoidal
```

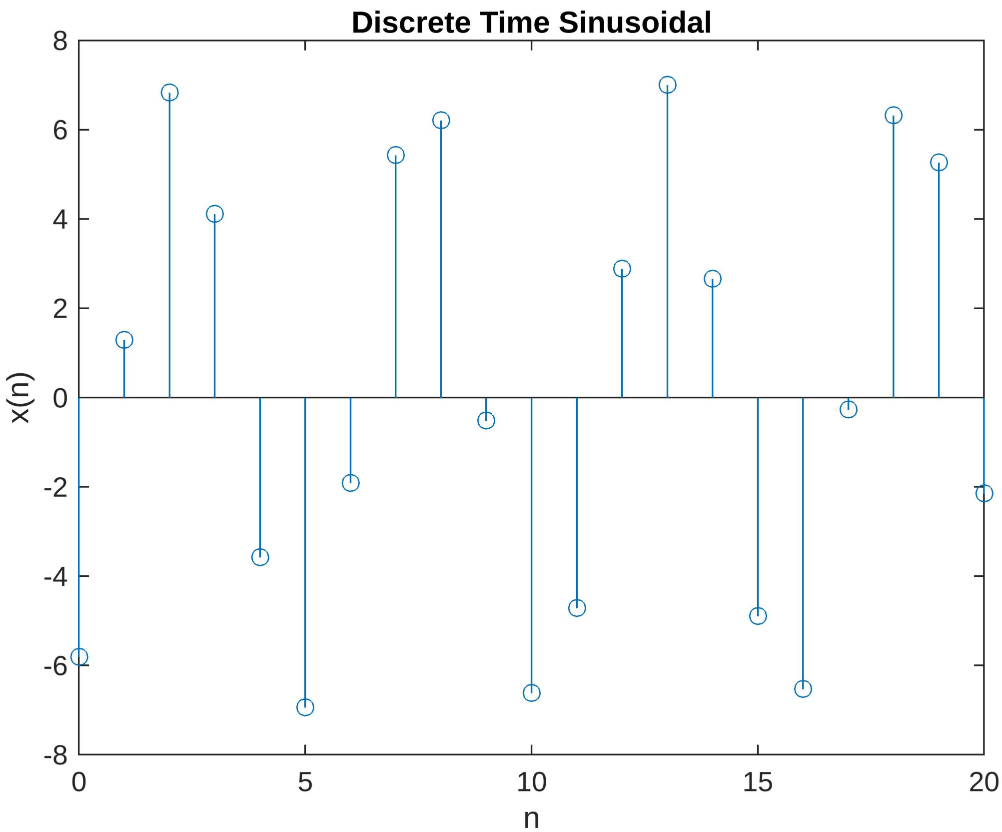
```
for k = 0:4
    n = 0:1:20;
    x_n = A*cos((w+2*pi*k)*n+phi);
    figure;
    stem(n,x_n);
    xlabel('n');
    ylabel('x(n)');
    title("Discrete Time Sinusoidal")
end
```


Discrete Time Sinusoidal
8
6
4
2
0
-2
-4
-6
-8
x(n)
0
5
10
15
20
n


Discrete Time Sinusoidal
8
6
4
2
0
-2
-4
-6
-8
x(n)
0
5
10
15
20
n


Discrete Time Sinusoidal
x(n)
n
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20


Discrete Time Sinusoidal
x(n)
n
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20



5 ompare the discrete-time sinusoids with their continuous - time counterparts.Discuss your observations.

```
% The continous time sinusoids have every point marked in their graph. thye
% have every point in the function.
% When compared to discrete the continuous sinusoids have high sampling
% rate.
% The continuous sequence are more accurate. The discrete sequnce is just
% the part of continous sequence.
```

6. Repeat the above experiment for a few more values of randomly chosen w_0 = [0,2pi] and phi = [0,2pi].

```
phi = rand * 2*pi
```

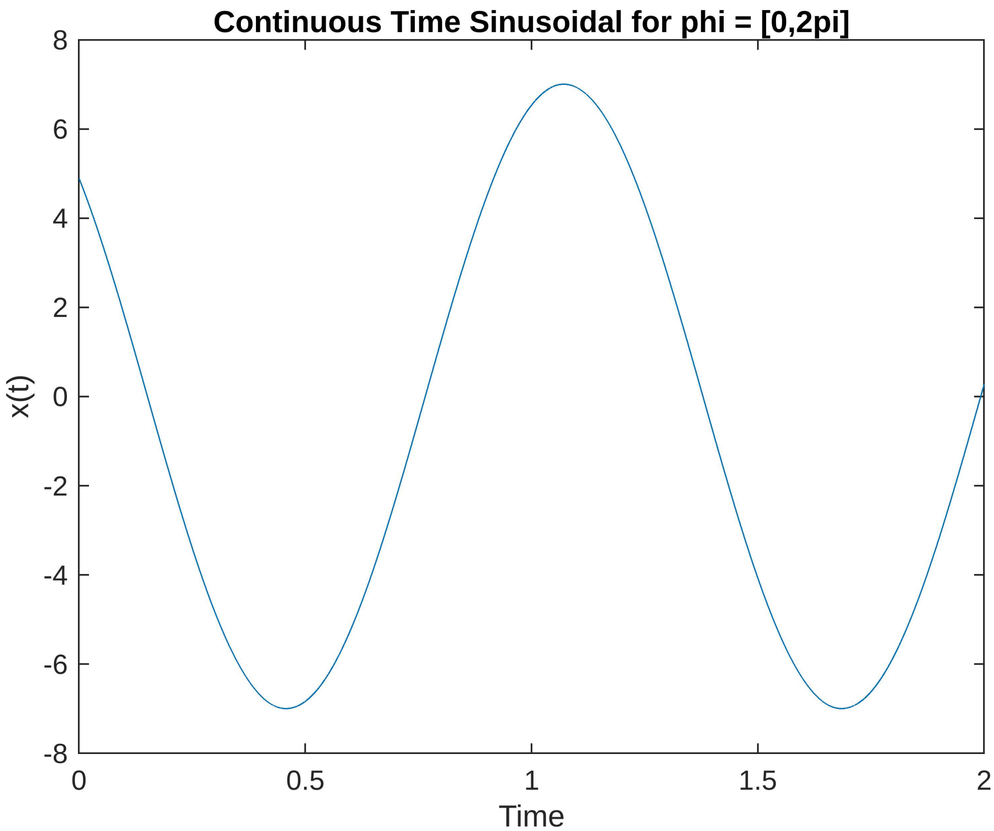
```
phi = 0.7979
```

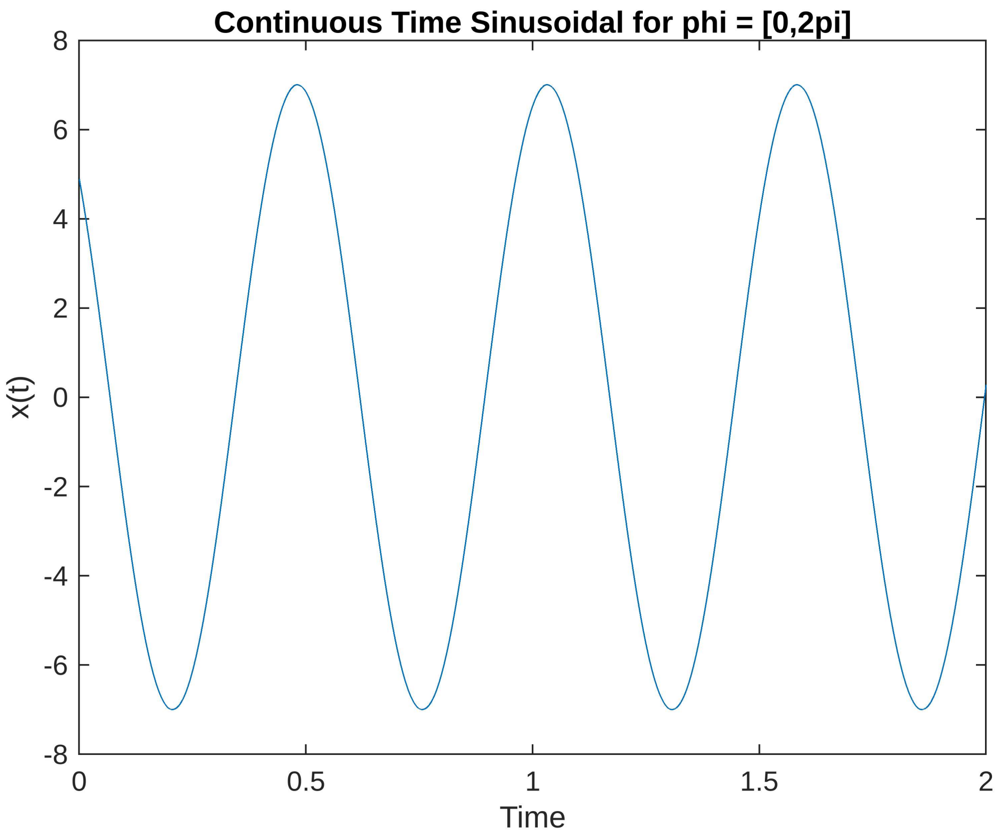
```
disp("Continuous Time Sinusoidal for phi = [0,2pi].");
```

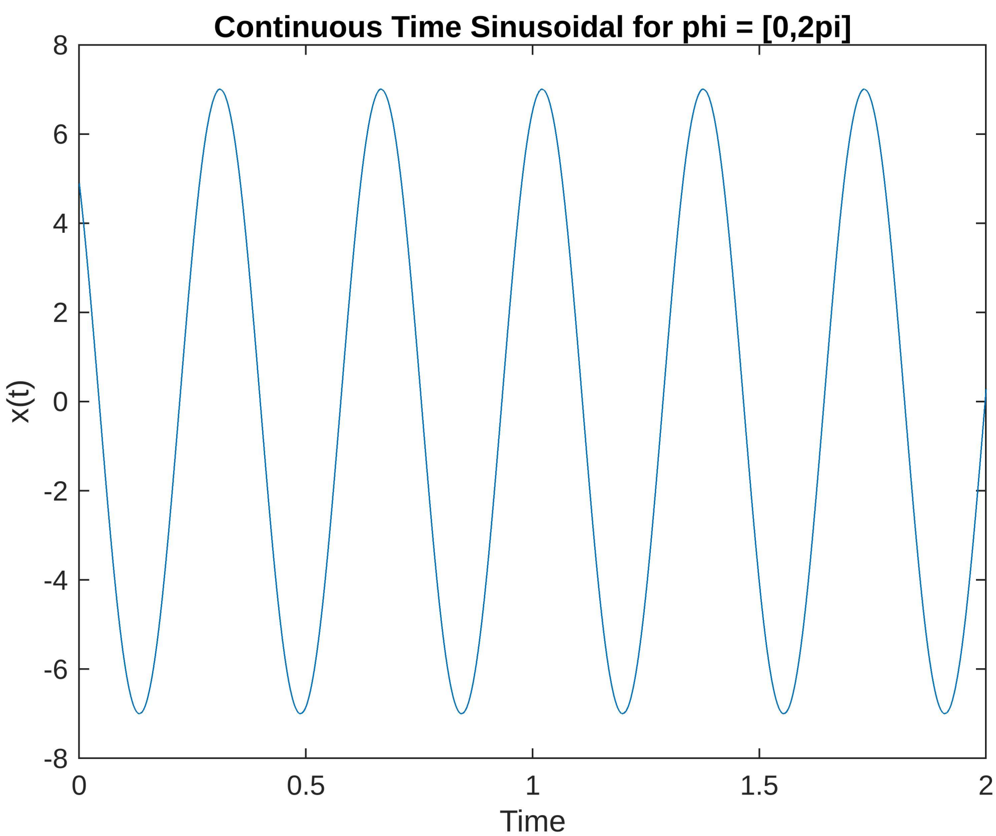
```
Continuous Time Sinusoidal for phi = [0,2pi].
```

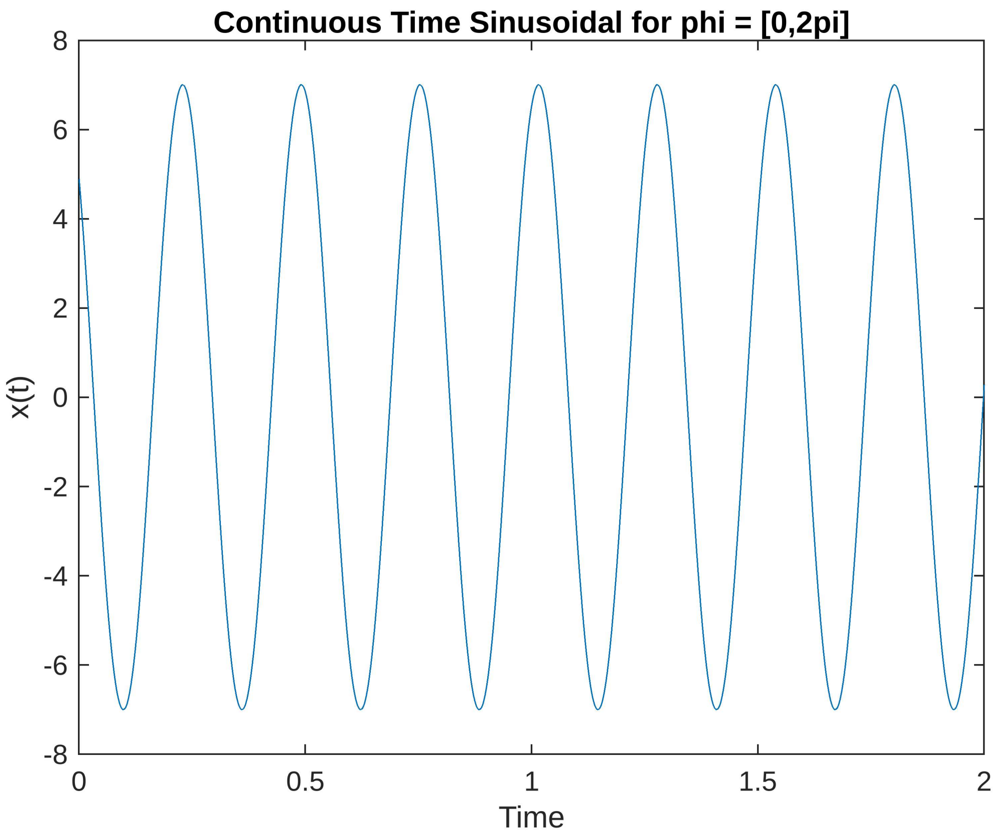
```
for k = 0:4
    t = 0:0.0001:2;
    x_t = A*cos((w+2*pi*k)*t+phi);
    figure;
    plot(t,x_t);
    xlabel('Time');
```

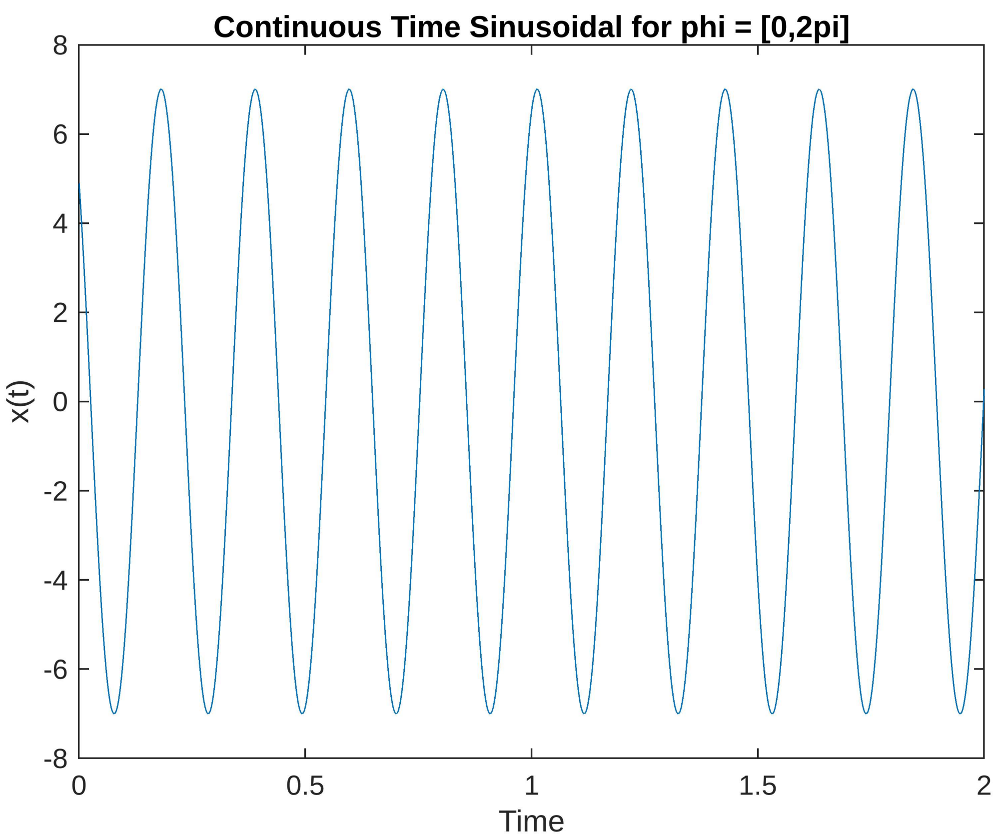
```
    ylabel('x(t)');
    title('Continuous Time Sinusoidal for phi = [0,2pi]');
end
```




Continuous Time Sinusoidal for phi = [0,2pi]
x(t)
Time
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2


Continuous Time Sinusoidal for phi = [0,2pi]
x(t)
Time
8
6
4
2
0
-2
-4
-6
-8
0
0.5
1
1.5
2

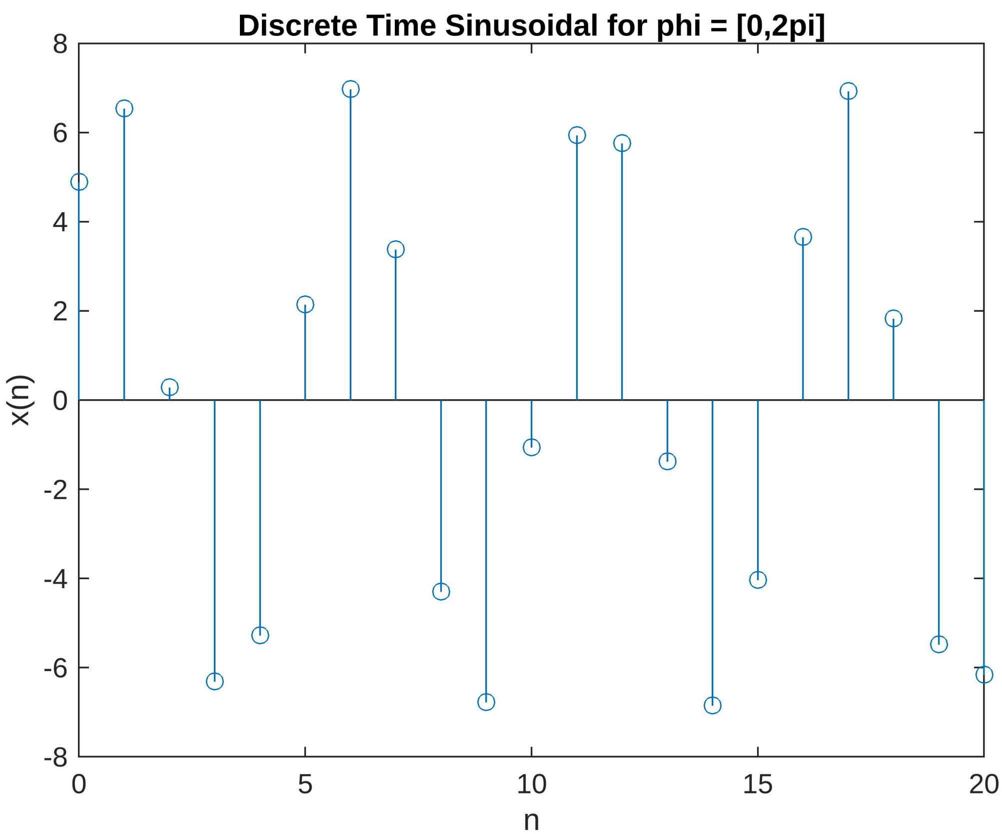


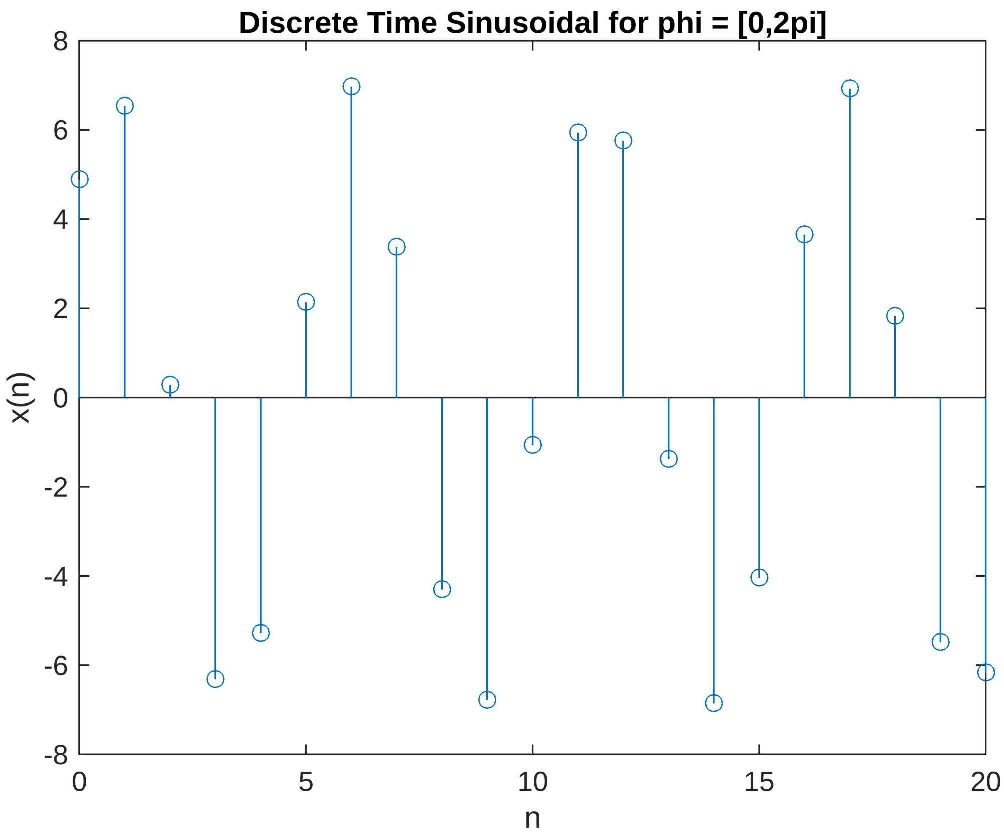


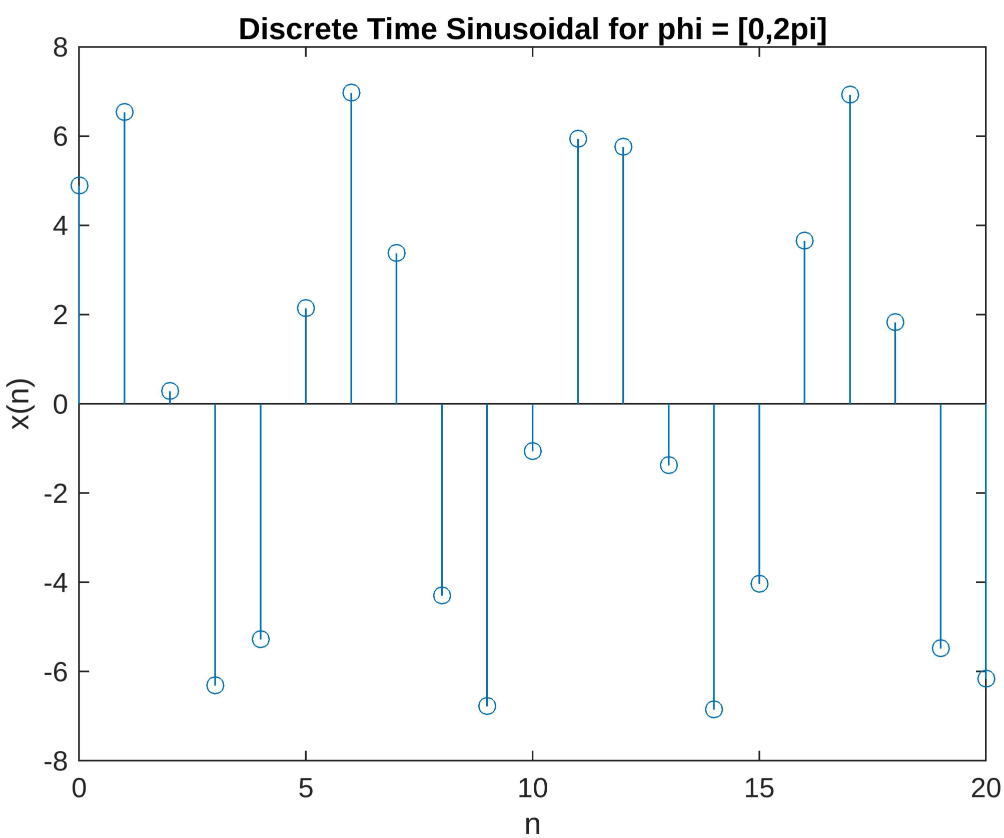

```
disp("Discrete Time Sinusoidal for phi = [0,2pi].");
```

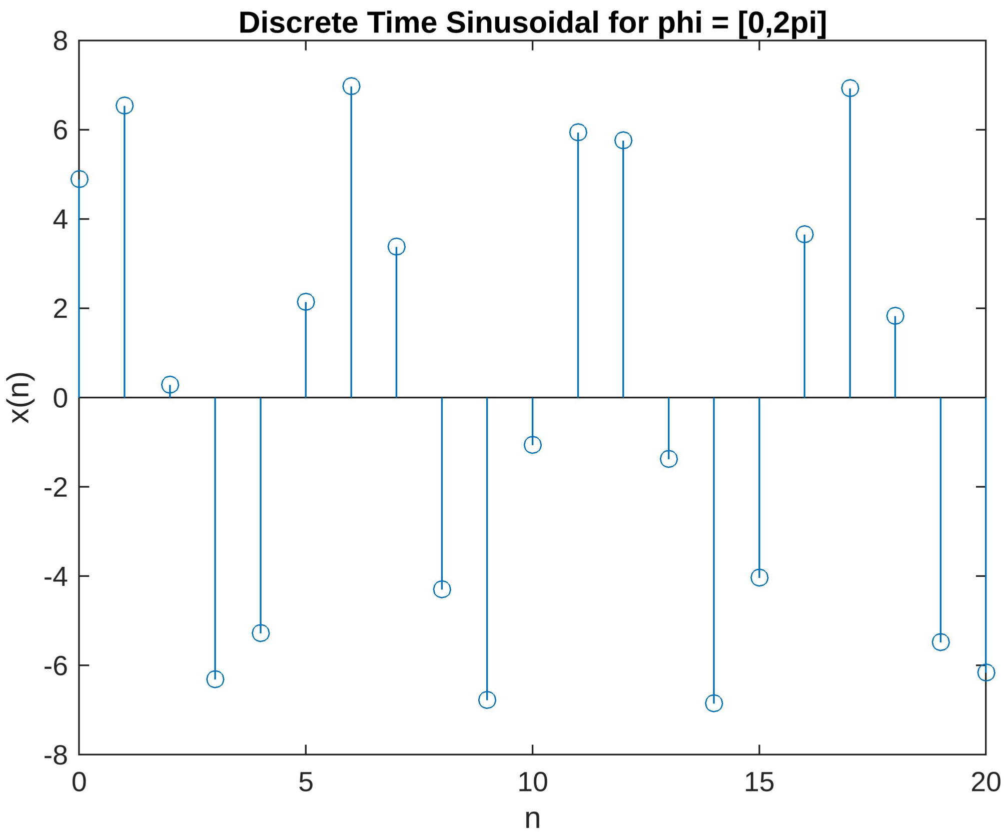
```
Discrete Time Sinusoidal for phi = [0,2pi].
```

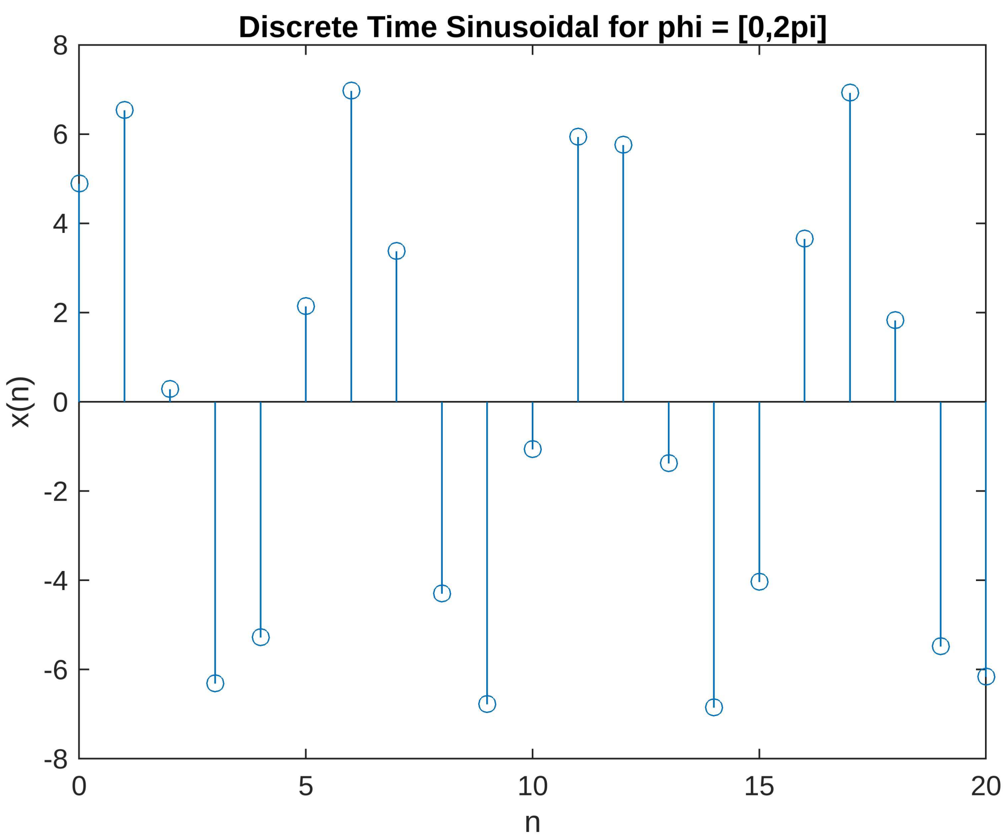
```
for k = 0:4
    n = 0:1:20;
    x_n = A*cos((w+2*pi*k)*n+phi);
    figure;
    stem(n,x_n);
    xlabel('n');
    ylabel('x(n)');
    title('Discrete Time Sinusoidal for phi = [0,2pi]');
end
```




Discrete Time Sinusoidal for phi = [0,2pi]
x(n)
n
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20


Discrete Time Sinusoidal for phi = [0,2pi]
x(n)
n
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20





2.) Frequencies within 0 and 2pi.

1 Fix any value of A.

```
A = 3;
```

2 Randomly generate a value of phi from -pi tp pi.

```
phi = -pi + 2*pi * rand
```

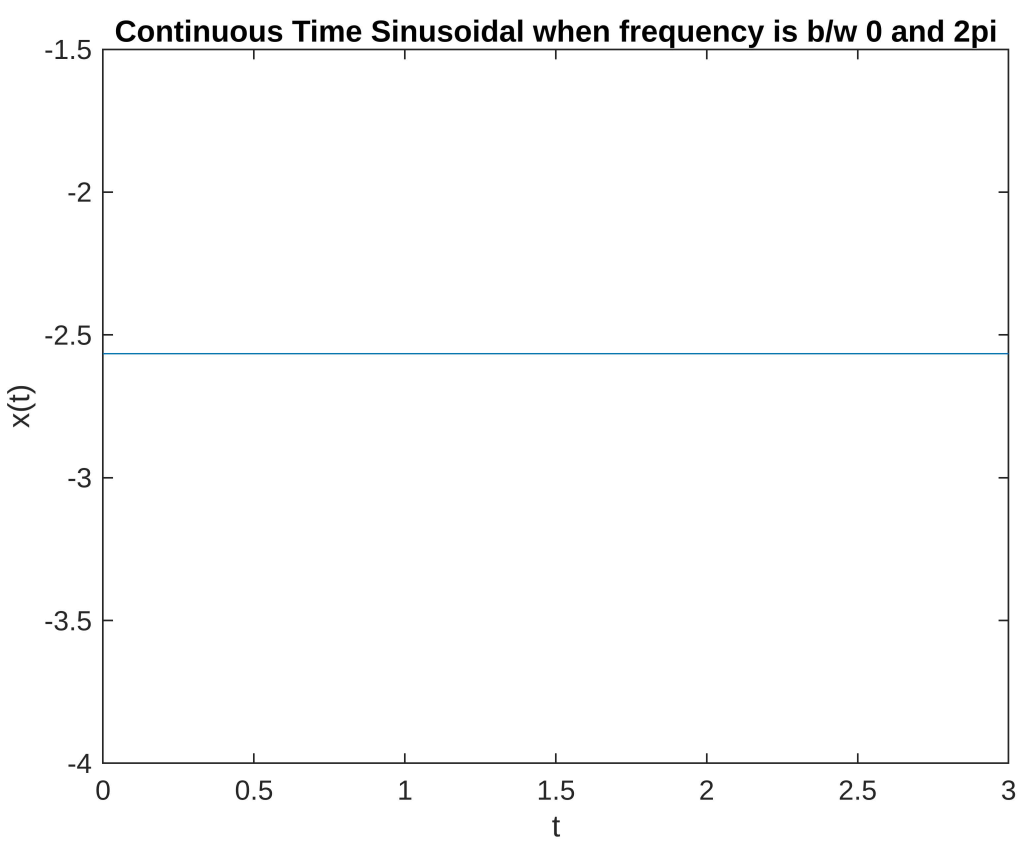
```
phi = 2.5973
```

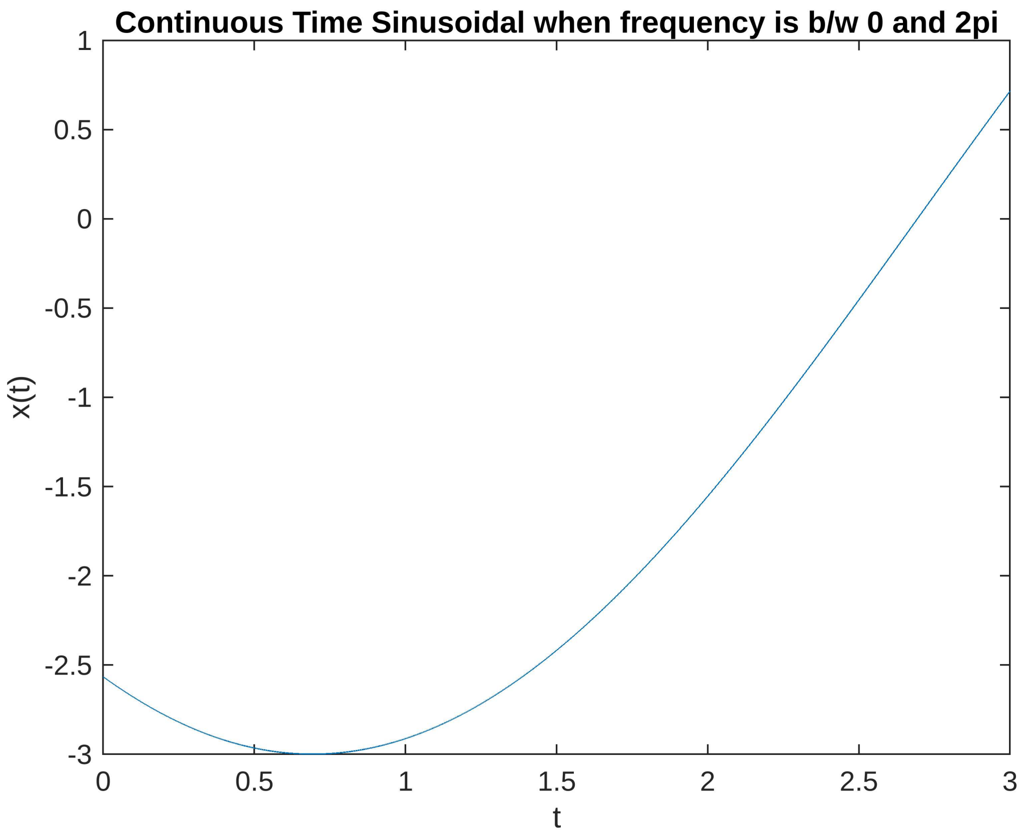
3 Sketch the continuous-time sinusoid x(t) = Acos(wt + phi) for Wo = Kpi/4 , K= 0 , . . ., 8

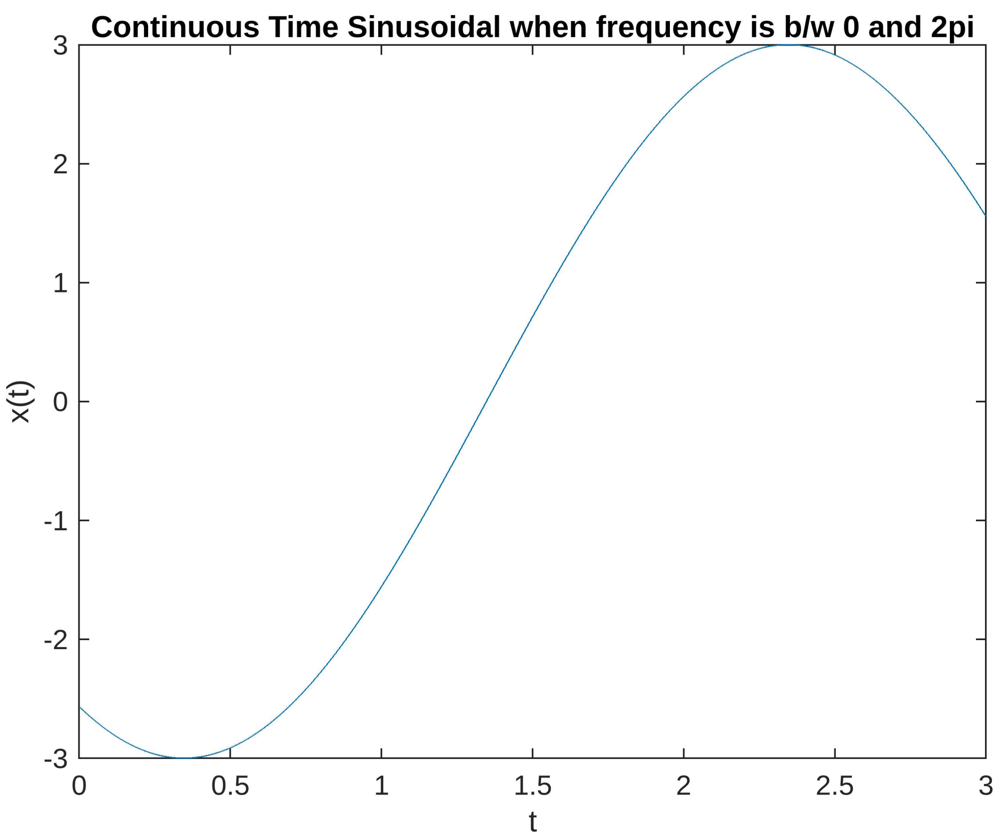
```
disp("Continuous Time Sinusoidal for phi = [-pi,pi] and w_0 = kpi/4 , k =
0,...,8.");
```

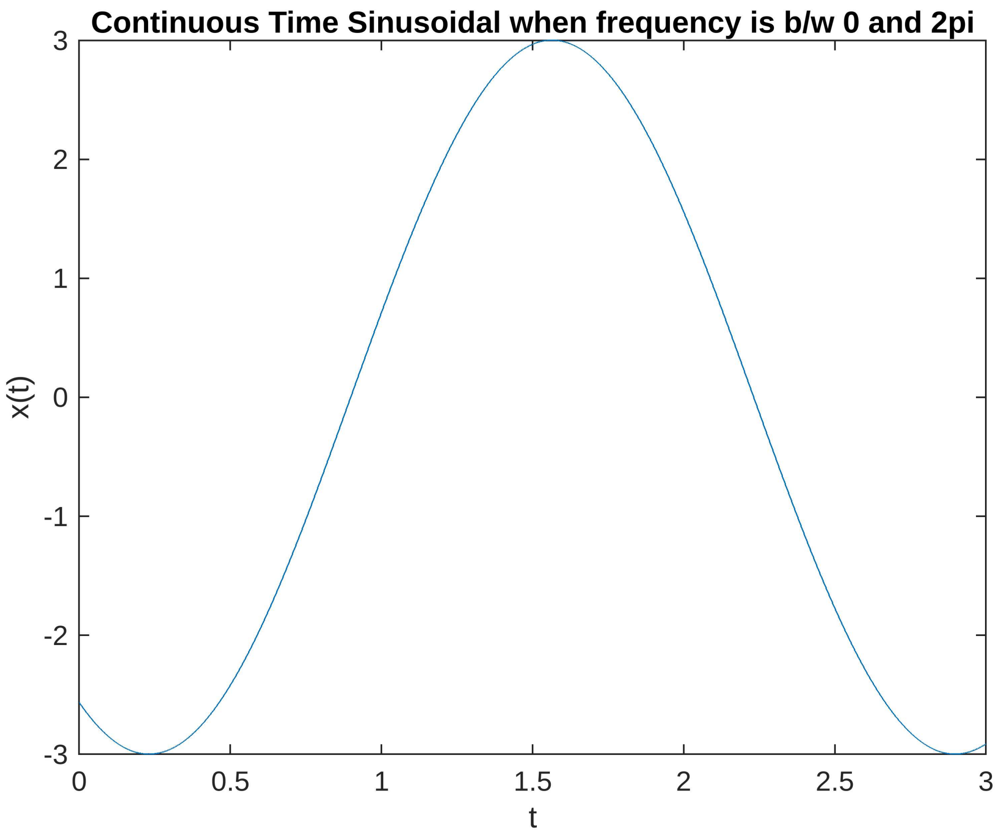
```
Continuous Time Sinusoidal for phi = [-pi,pi] and w_0 = kpi/4 , k = 0,...,8.
```

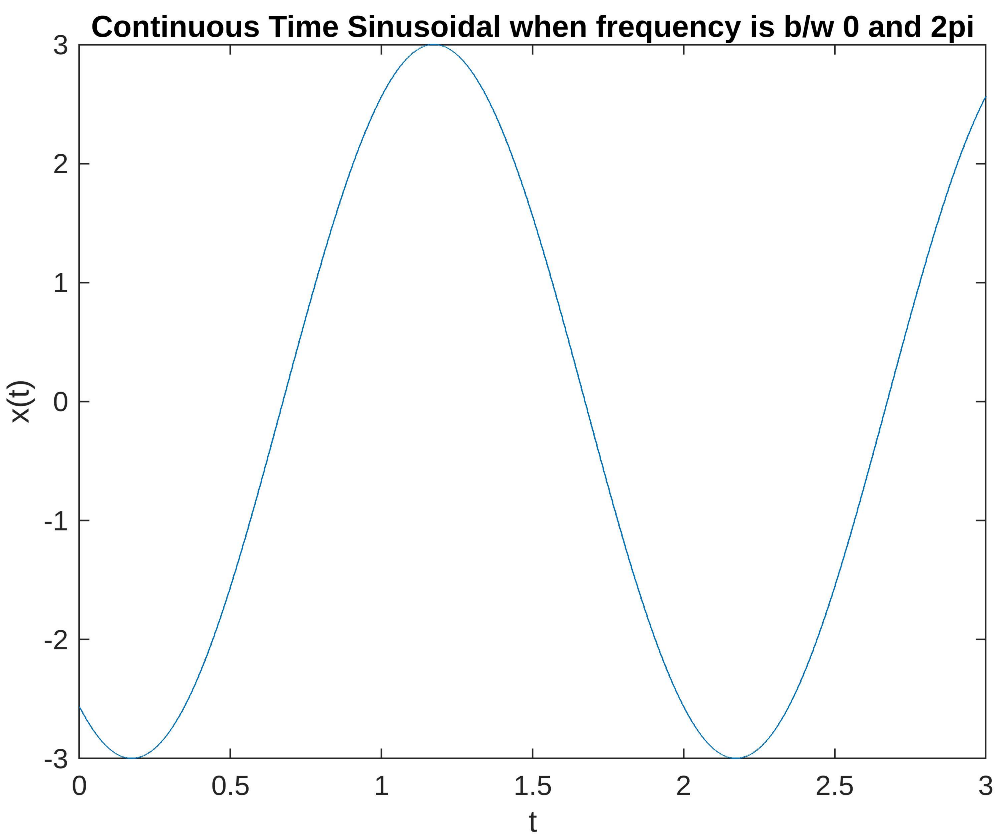
```
for k = 0:8
    w = k*(pi/4);
    t = 0:0.001:3;
    x_t = A*cos(w*t + phi);
    figure;
    plot(t,x_t);
    xlabel('t');
    ylabel('x(t)');
    title('Continuous Time Sinusoidal when frequency is b/w 0 and 2pi');
end
```

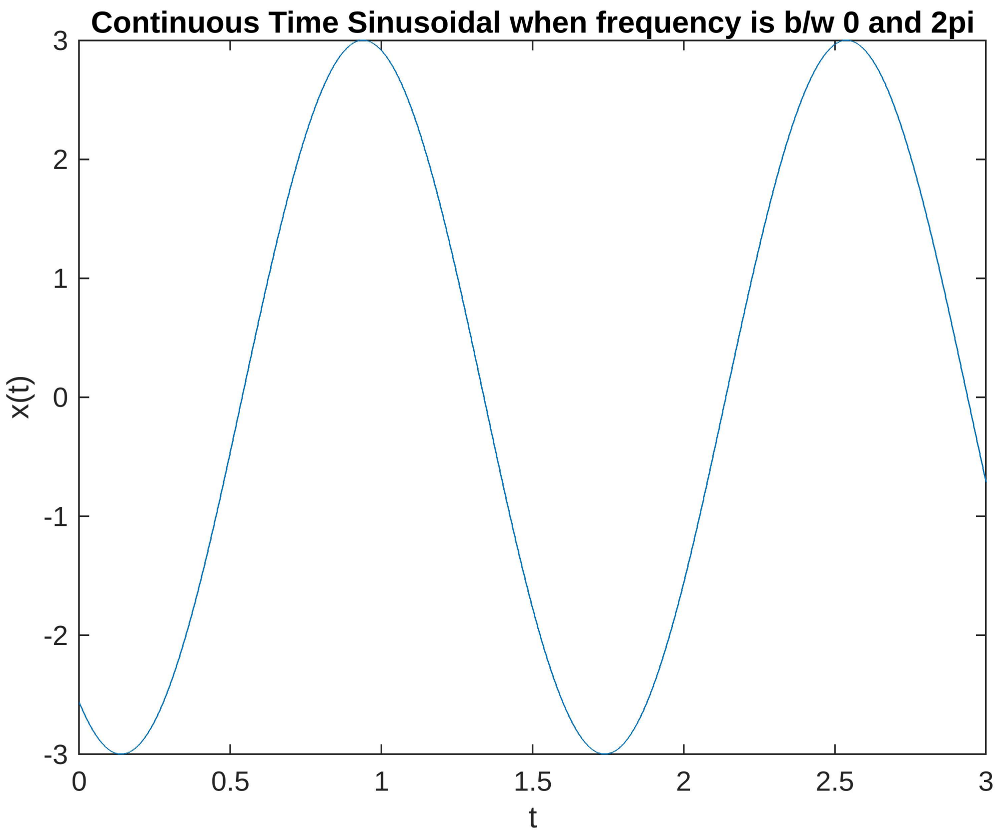


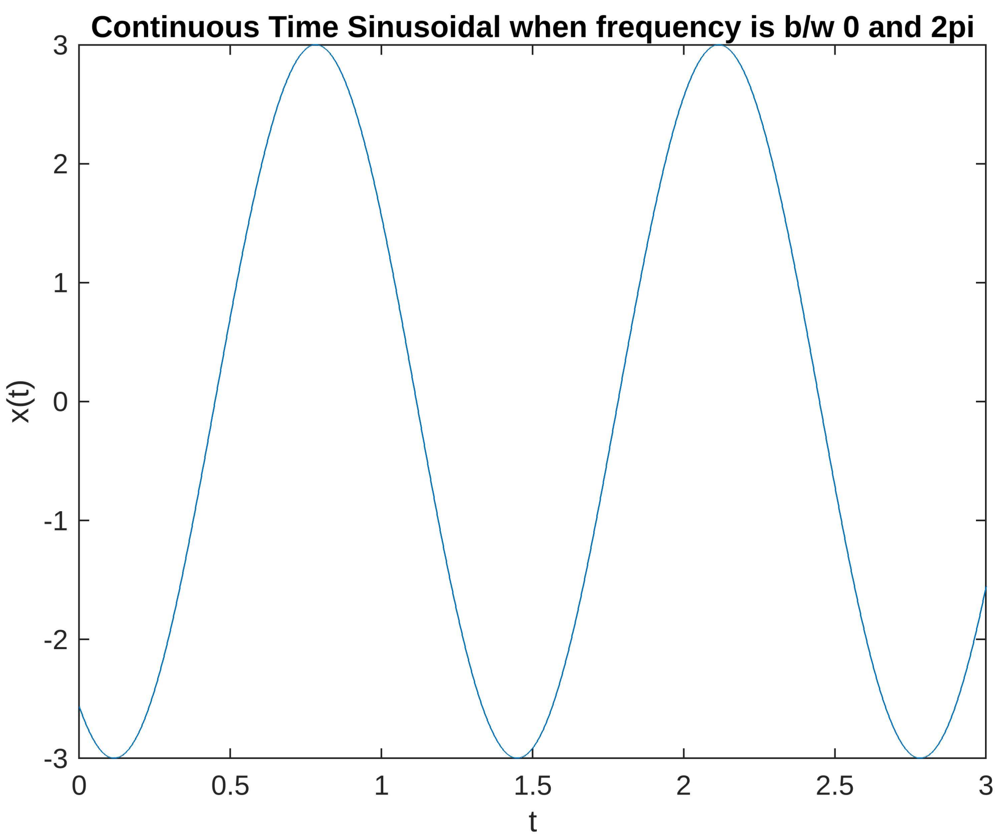

Continuous Time Sinusoidal when frequency is b/w 0 and 2pi
x(t)
t
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
0
0.5
1
1.5
2
2.5
3

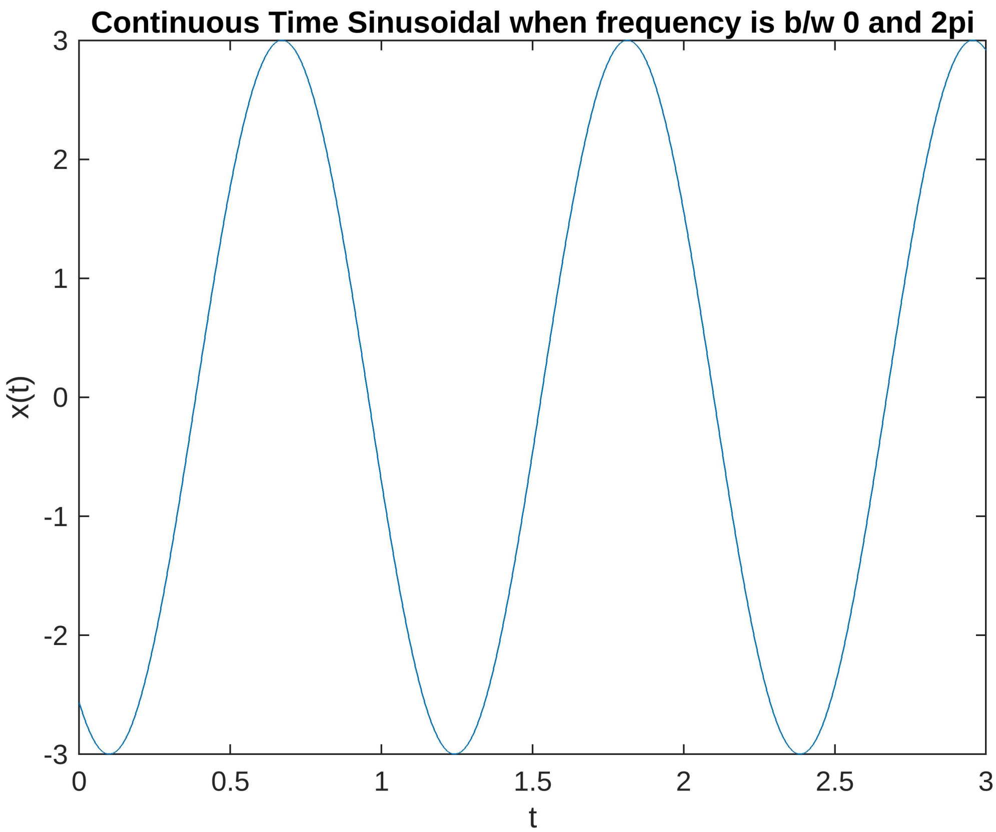

Continuous Time Sinusoidal when frequency is b/w 0 and 2pi
x(t)
t
3
2
1
0
-1
-2
-3
0
0.5
1
1.5
2
2.5
3

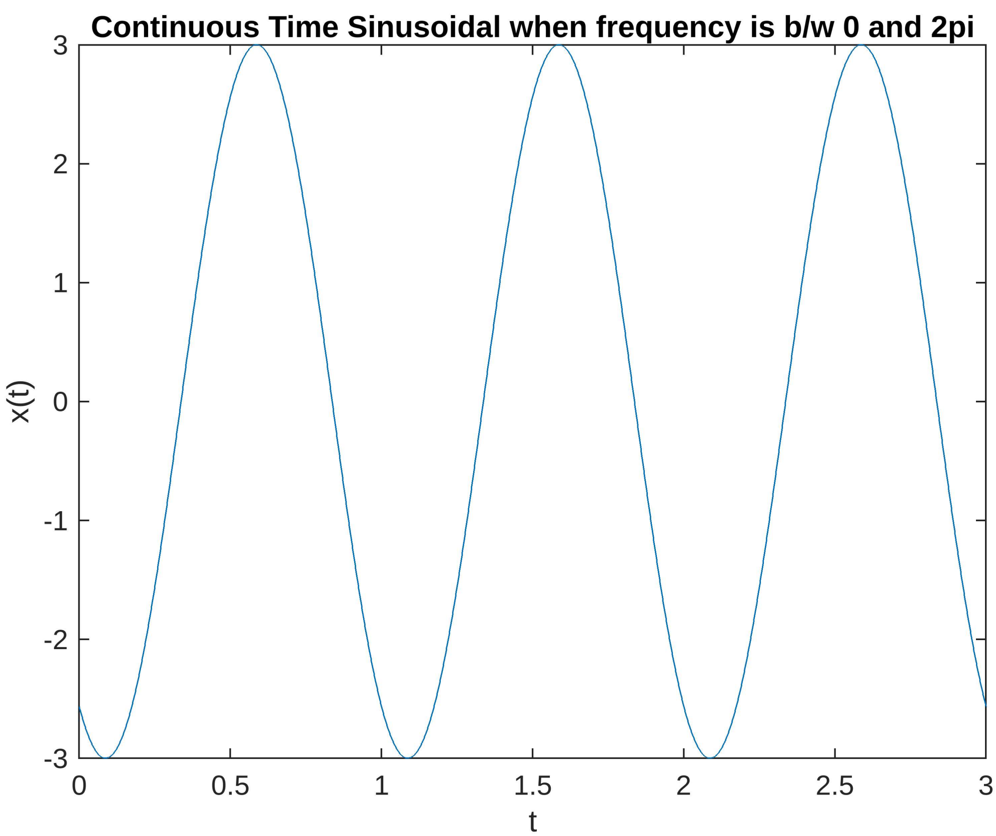

Continuous Time Sinusoidal when frequency is b/w 0 and 2pi
x(t)
t
3
2
1
0
-1
-2
-3
0
0.5
1
1.5
2
2.5
3


Continuous Time Sinusoidal when frequency is b/w 0 and 2pi
x(t)
t
3
2
1
0
-1
-2
-3
0
0.5
1
1.5
2
2.5
3


Continuous Time Sinusoidal when frequency is b/w 0 and 2pi
x(t)
t
3
2
1
0
-1
-2
-3
0
0.5
1
1.5
2
2.5
3


Continuous Time Sinusoidal when frequency is b/w 0 and 2pi
x(t)
t
3
2
1
0
-1
-2
-3
0
0.5
1
1.5
2
2.5
3



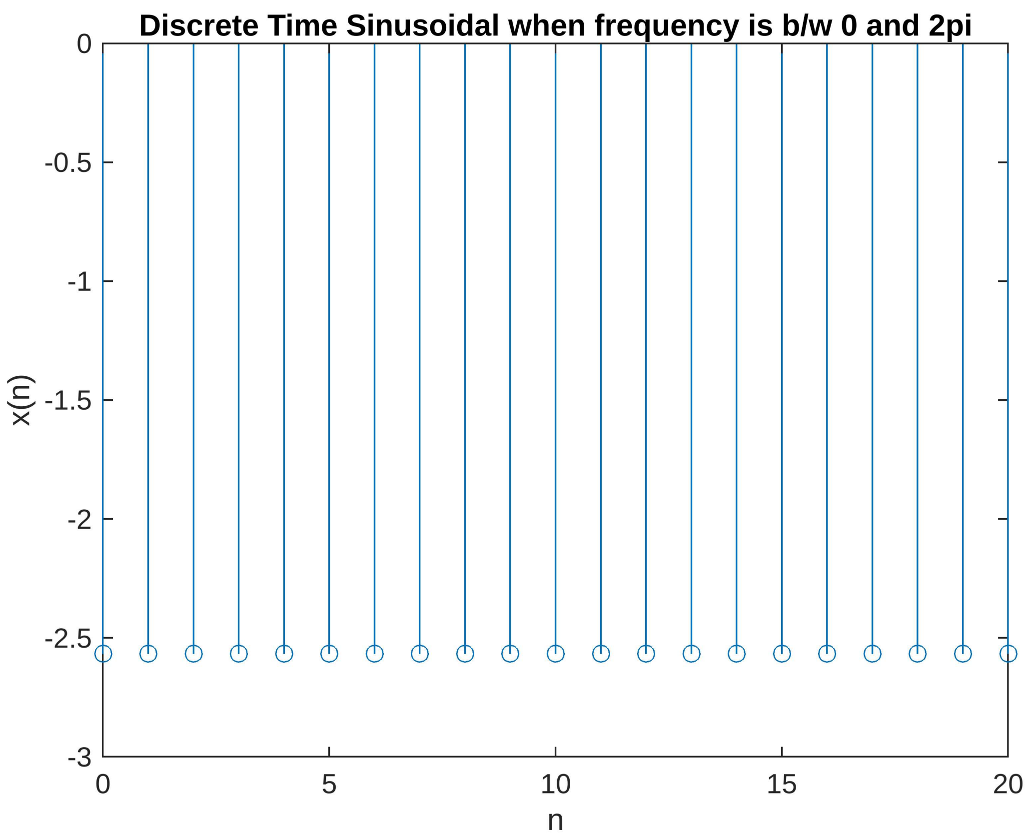


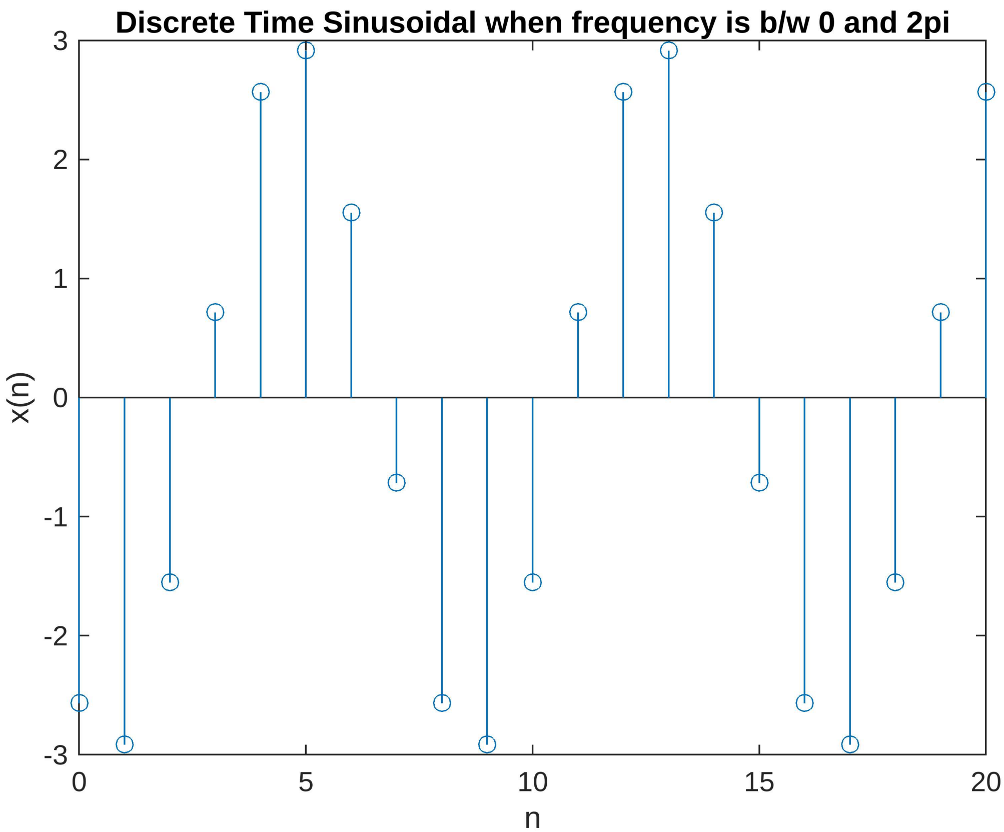
4 The same as above in discrete form.

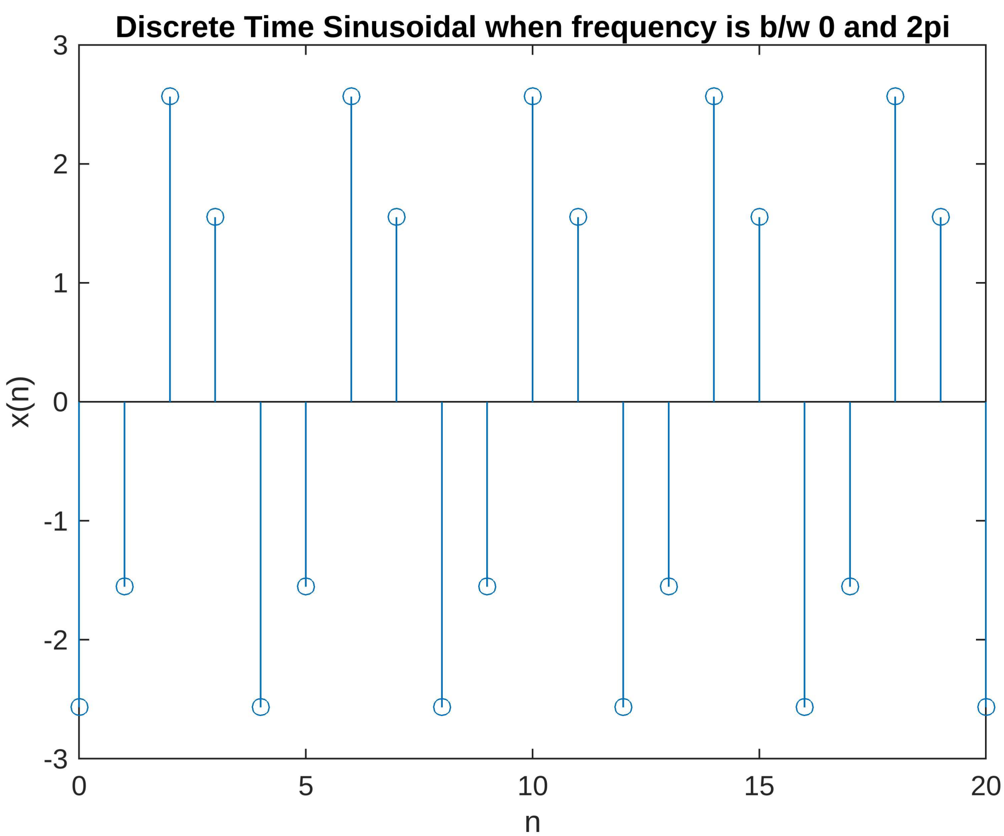
```
disp("Discrete Time Sinusoidal for phi = [-pi,pi] and w_0 = kpi/4 , k = 
0,...,8.");
```

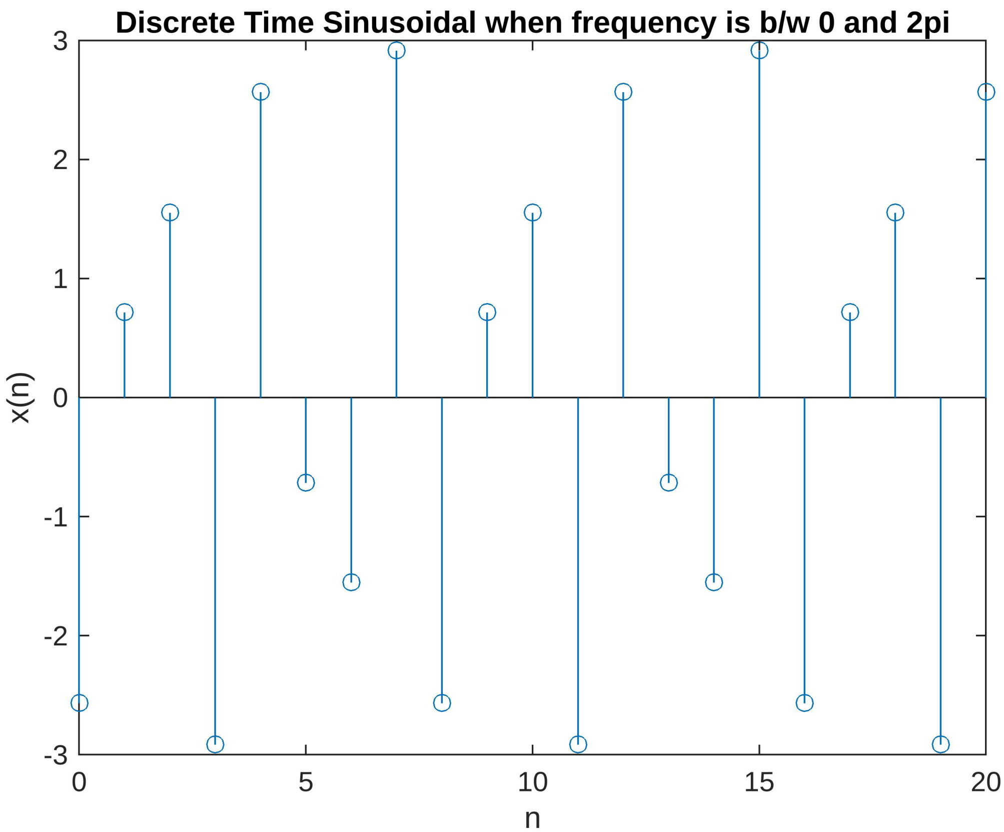
```
Discrete Time Sinusoidal for phi = [-pi,pi] and w_0 = kpi/4 , k = 0,...,8.
```

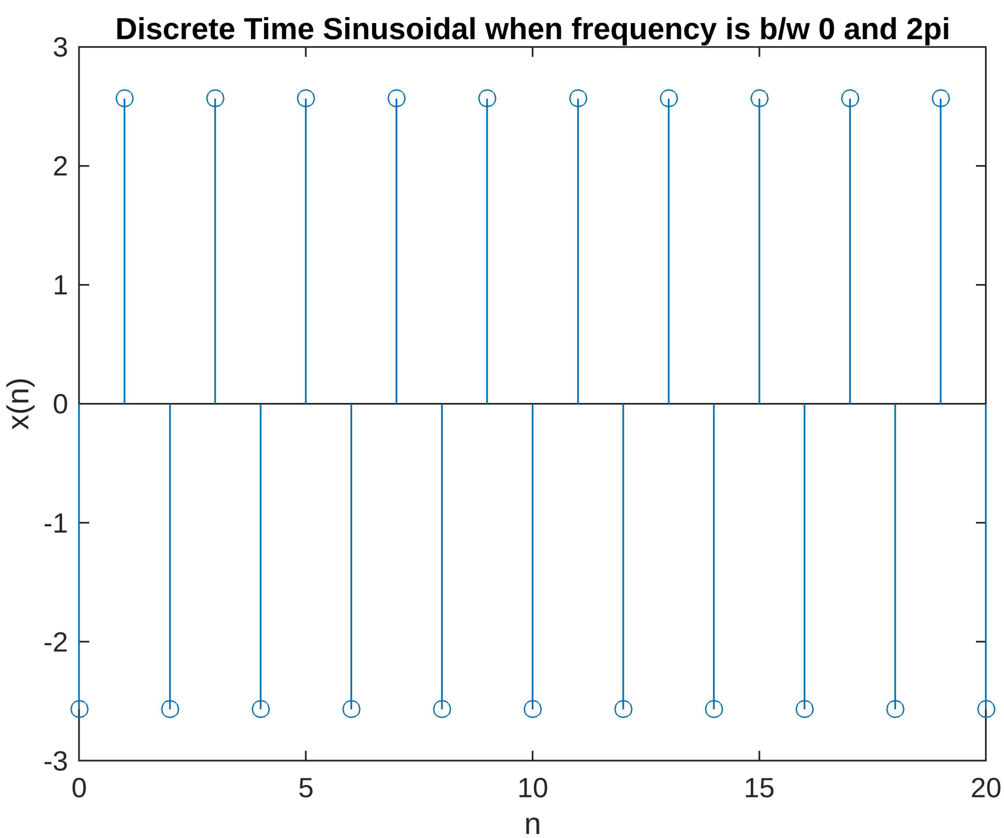
```
for k = 0:8
    w = k*(pi/4);
    n = 0:1:20;
    x_n = A*cos(w*n + phi);
    figure;
    stem(n,x_n);
    xlabel('n');
    ylabel('x(n)');
    title('Discrete Time Sinusoidal when frequency is b/w 0 and 2pi')
end
```

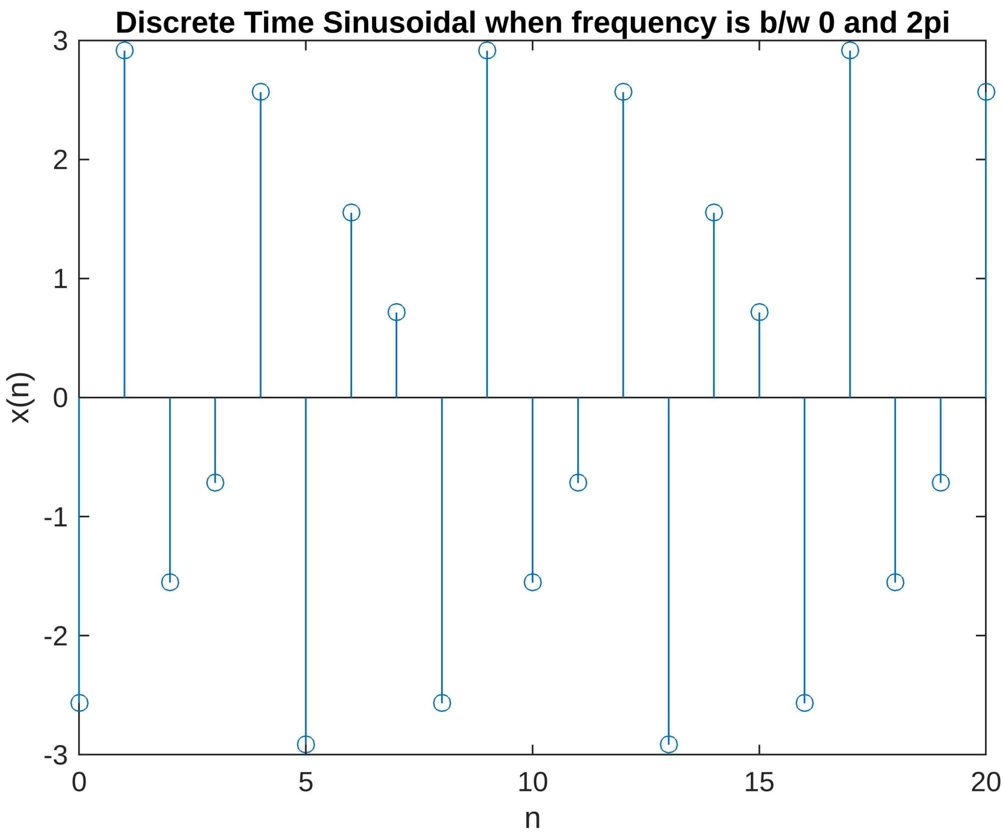


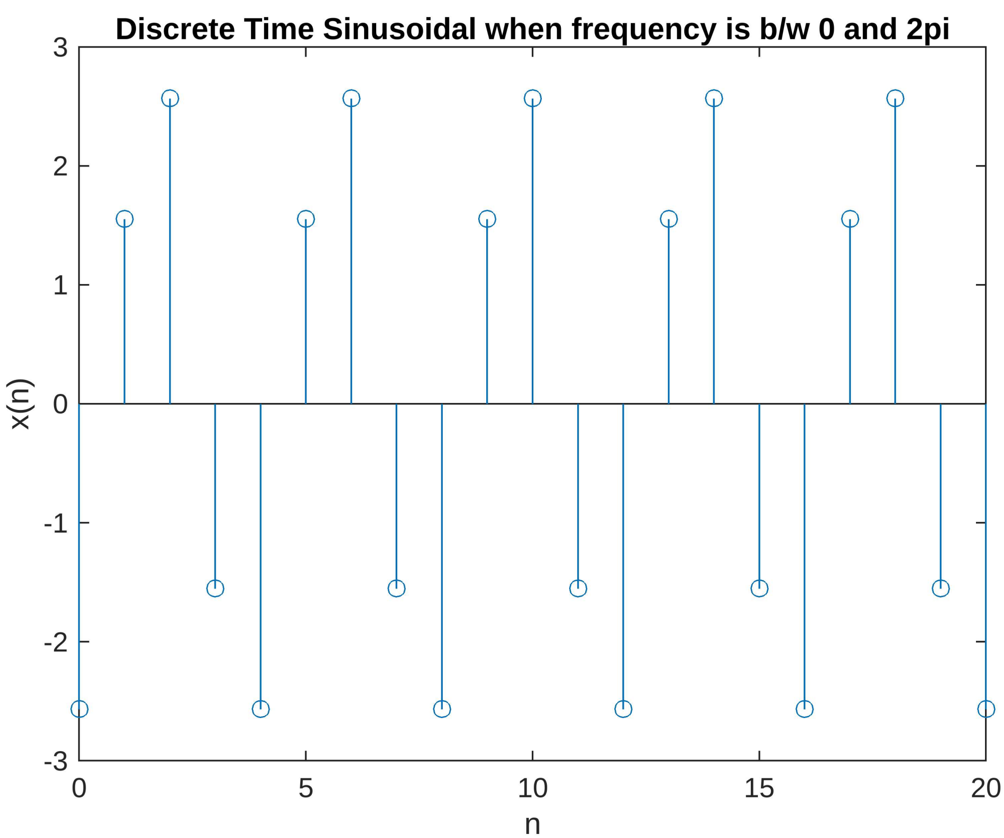

Discrete Time Sinusoidal when frequency is b/w 0 and 2pi
x(n)
n
3
2
1
0
-1
-2
-3
0
5
10
15
20

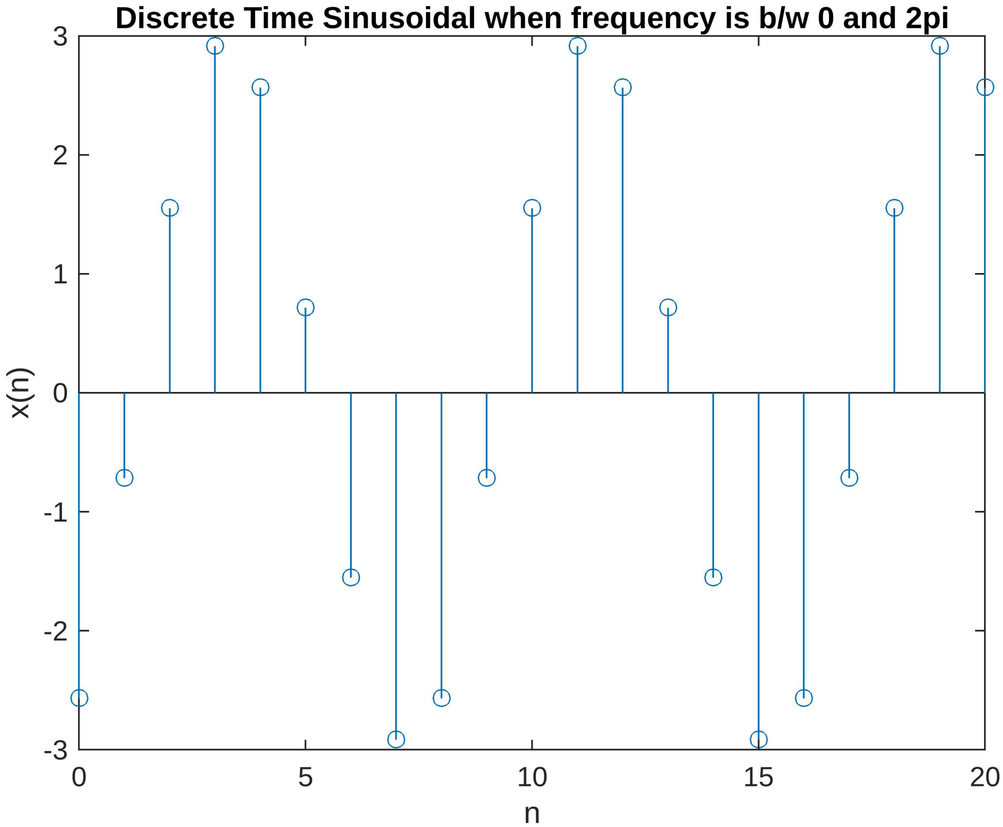

Discrete Time Sinusoidal when frequency is b/w 0 and 2pi
x(n)
n
3
2
1
0
-1
-2
-3
0
5
10
15
20

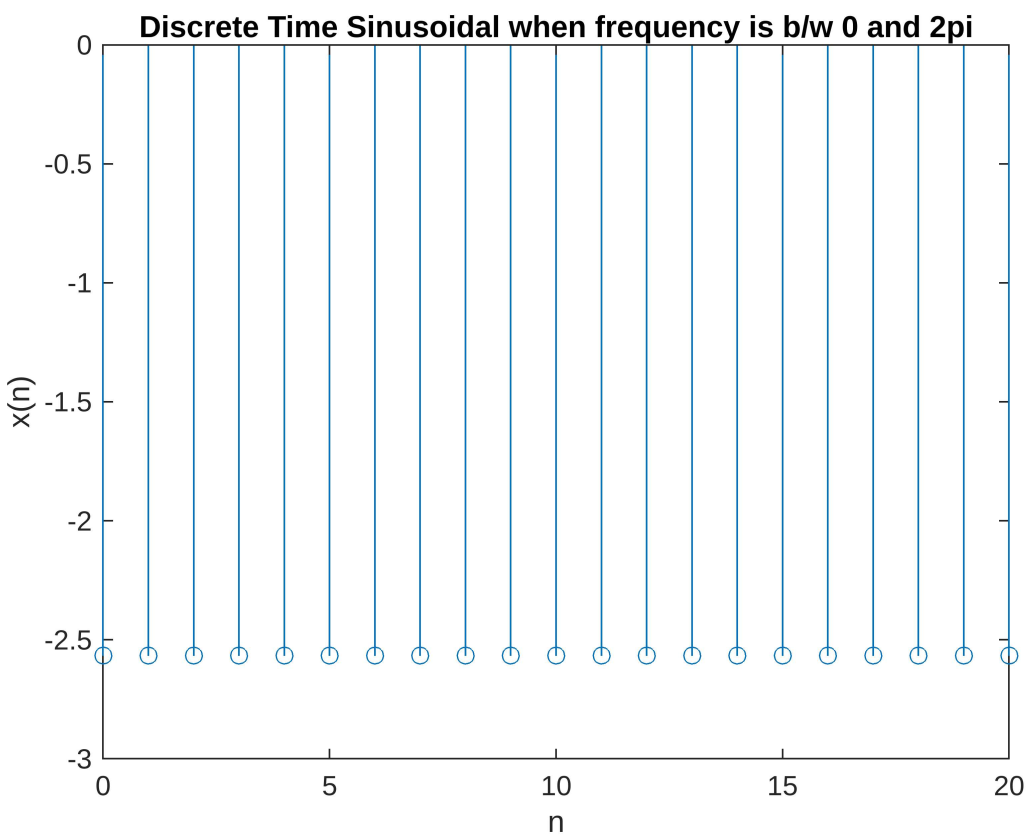

Discrete Time Sinusoidal when frequency is b/w 0 and 2pi
x(n)
n
3
2
1
0
-1
-2
-3
0
5
10
15
20


Discrete Time Sinusoidal when frequency is b/w 0 and 2pi
x(n)
n
3
2
1
0
-1
-2
-3
0
5
10
15
20


Discrete Time Sinusoidal when frequency is b/w 0 and 2pi
x(n)
n
3
2
1
0
-1
-2
-3
0
5
10
15
20


Discrete Time Sinusoidal when frequency is b/w 0 and 2pi
x(n)
n
3
2
1
0
-1
-2
-3
0
5
10
15
20





5 compare the discrete-time sinusoids with their continuous - time counterparts.Discuss your observations.

```
% The continous time sinusoids have every point marked in their graph. thye
% have every point in the function.
% When compared to discrete the continuous sinusoids have high sampling
% rate.
% The continuous sequence are more accurate. The discrete sequnce is just
% the part of continous sequence.
```

3.) Periodicity

1 Fix an value of A.

```
A = 5;
```

2 Randomly generate a value of phi from -pi tp pi.

```
phi = -pi + 2*pi * rand
```

```
phi = 0.8316
```

3 Sketch the continuous-time signals

x1(t) = Acos(pi*t/4 + phi)

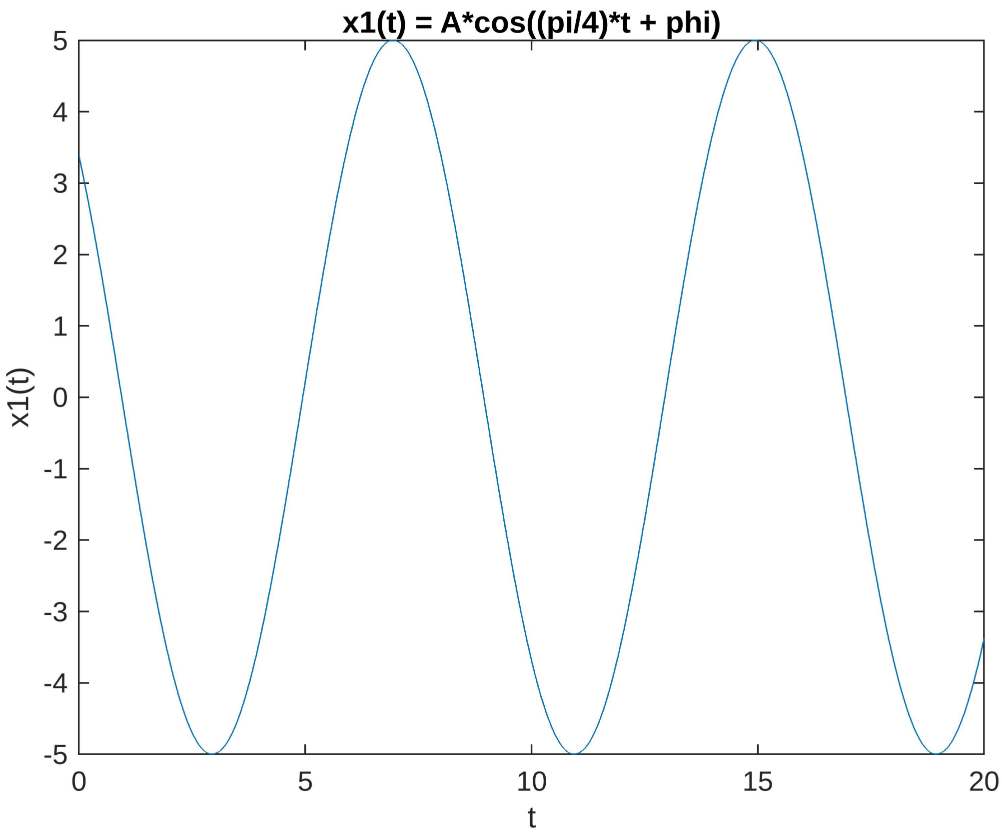
x2(t) = Acos(3pi/8 * t + phi)

x3(t) = Acos(t +phi)

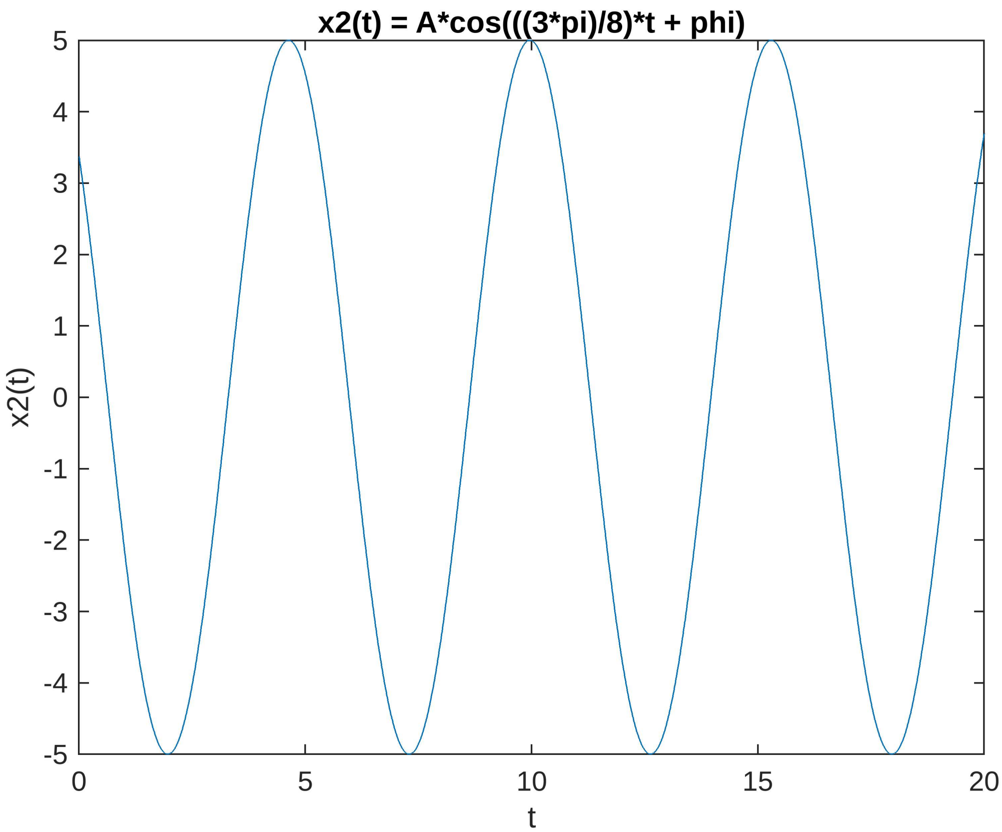
```
disp('The comtinuous time signals.')
```

```
The comtinuous time signals.
```

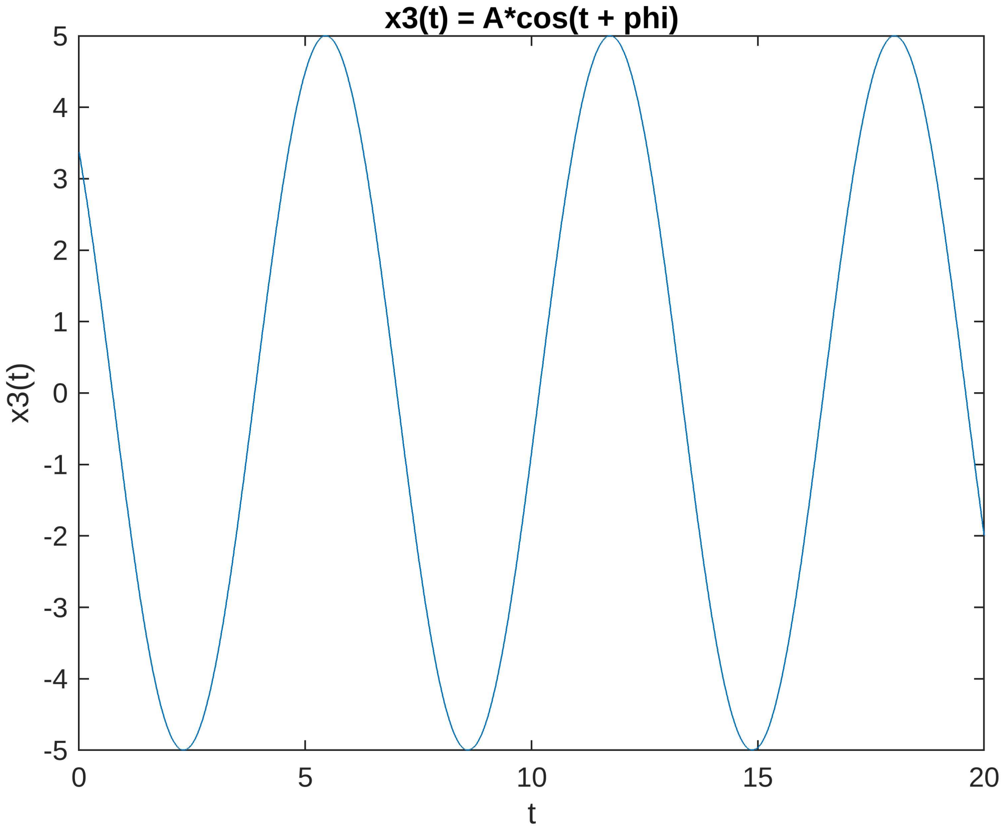
```
t = 0:0.01:20;
x1_t = A*cos((pi/4)*t + phi);
x2_t = A*cos(((3*pi)/8)*t + phi);
x3_t = A*cos(t + phi);
figure;
plot(t,x1_t);
xlabel('t');
ylabel('x1(t)');
title('x1(t) = A*cos((pi/4)*t + phi)');
```




```
figure;
plot(t,x2_t);
xlabel('t');
ylabel('x2(t)');
title('x2(t) = A*cos(((3*pi)/8)*t + phi)')
```




```
figure;
plot(t,x3_t);
xlabel('t');
ylabel('x3(t)');
title('x3(t) = A*cos(t + phi)');
```

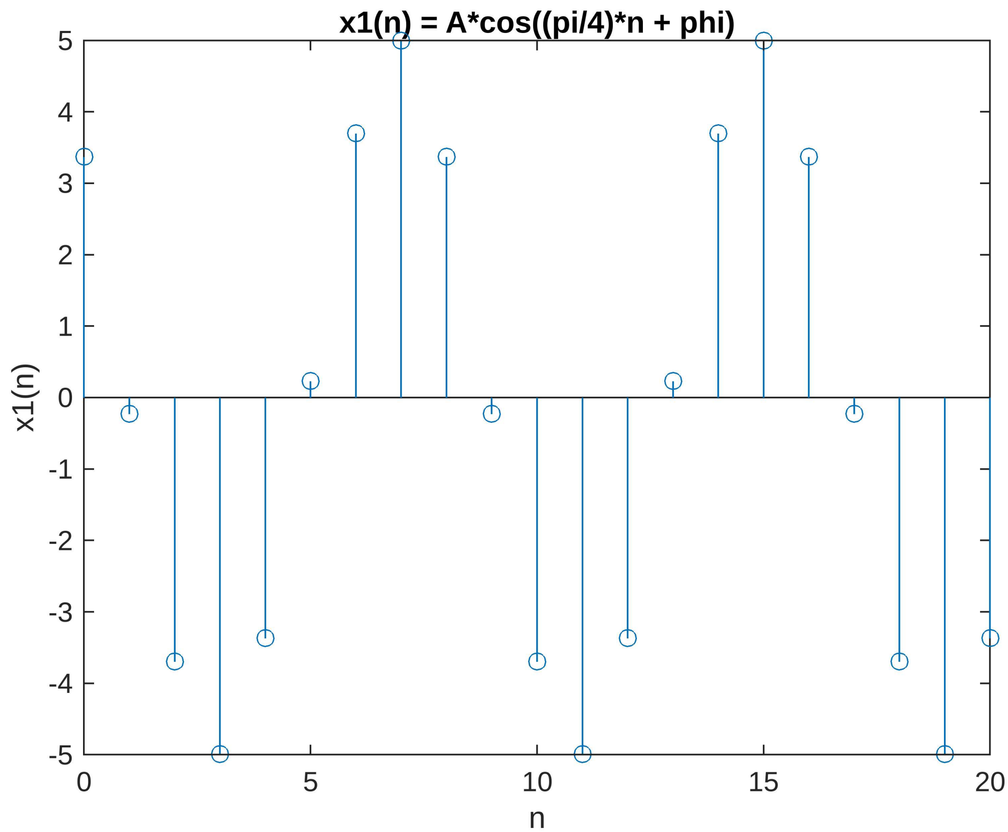


4 Now discrete signals of the above.

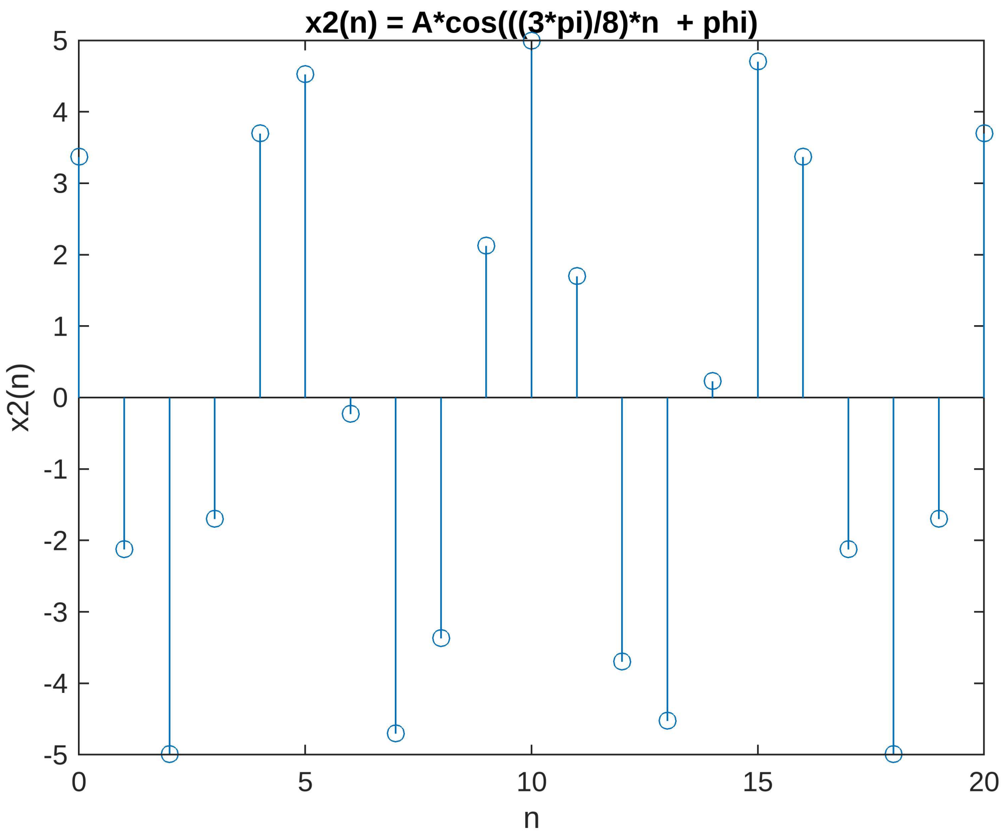
```
disp('The Discrete time signals.')
```

```
The Discrete time signals.
```

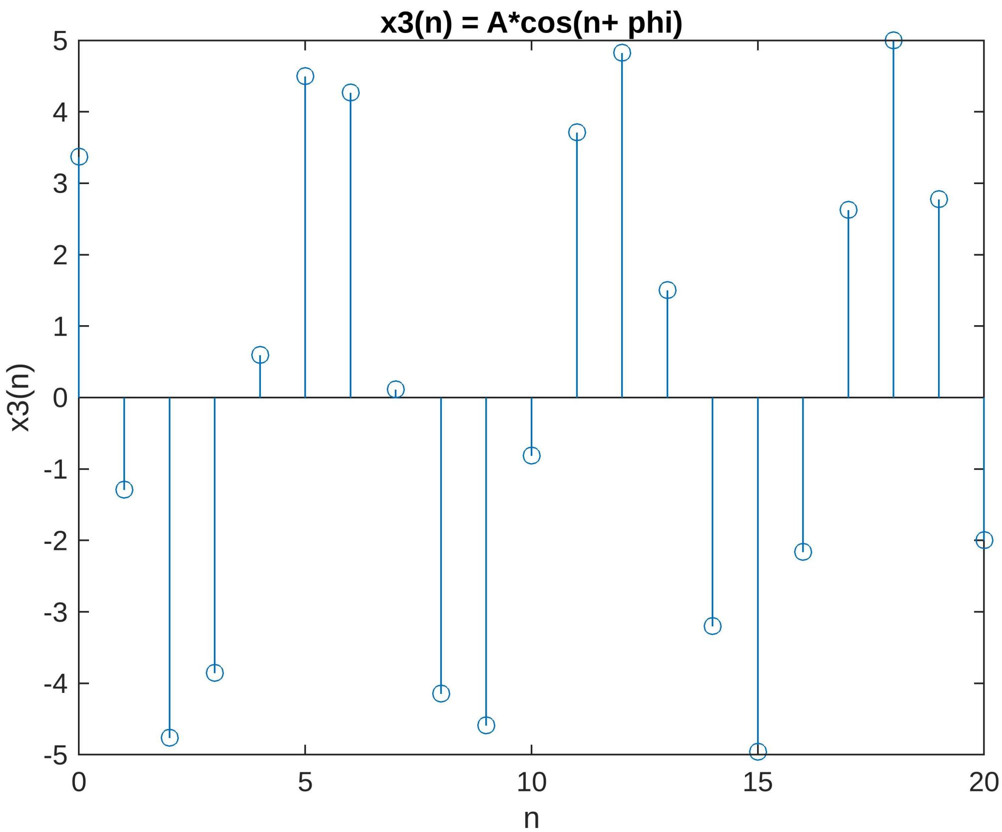
```
n = 0:1:20;
x1_n = A*cos((pi/4)*n + phi);
x2_n = A*cos(((3*pi)/8)*n  + phi);
x3_n = A*cos(n+ phi);
figure;
stem(n,x1_n);
xlabel('n');
ylabel('x1(n)');
title("x1(n)  = A*cos((pi/4)*n + phi)");
```




```
figure;
stem(n,x2_n);
xlabel('n');
ylabel('x2(n)');
title('x2(n) = A*cos(((3*pi)/8)*n  + phi)');
```




```
figure;
stem(n,x3_n);
xlabel('n');
ylabel('x3(n)');
title('x3(n) = A*cos(n+ phi)');
```



5 compare the discrete-time signals with their continuous - time counterparts.Discuss your observations.

```
% The continous time sinusoids have every point marked in their graph. thye
% have every point in the function.
% When compared to discrete the continuous sinusoids have high sampling
% rate.
% The continuous sequence are more accurate. The discrete sequnce is just
% the part of continous sequence.
```

B . EXPONENTIAL SEQUENCE

1 Fix an value of A.

```
A = 9;
```

2 Sketch x[n] = A*alp^n for the following values of randomly generated :

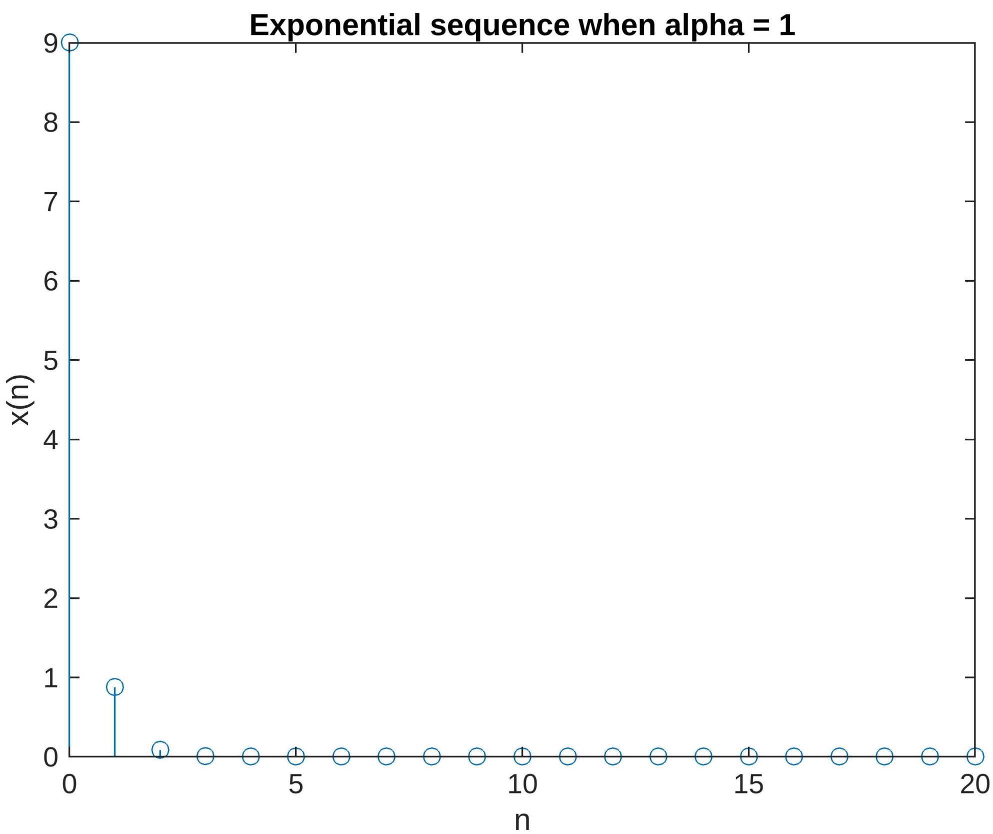
1. alp = [0,1];

2. alp = [1,10];

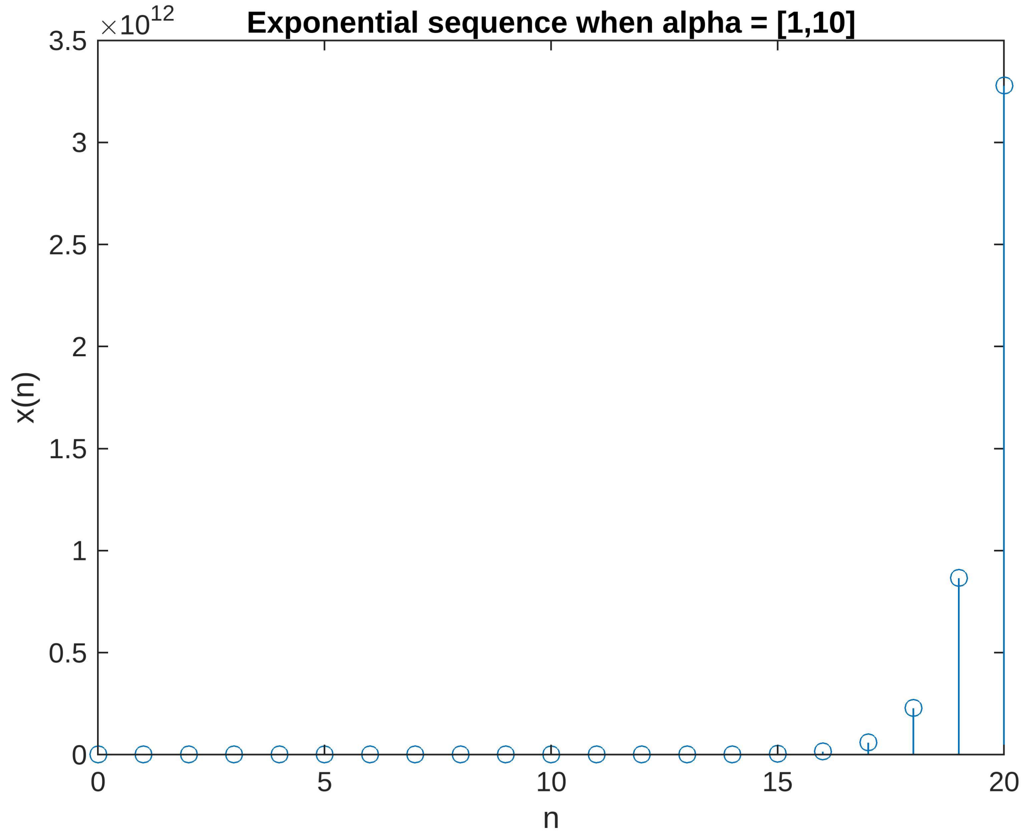
3. alp = [-1,0];

4 . alp = [-10,-1];

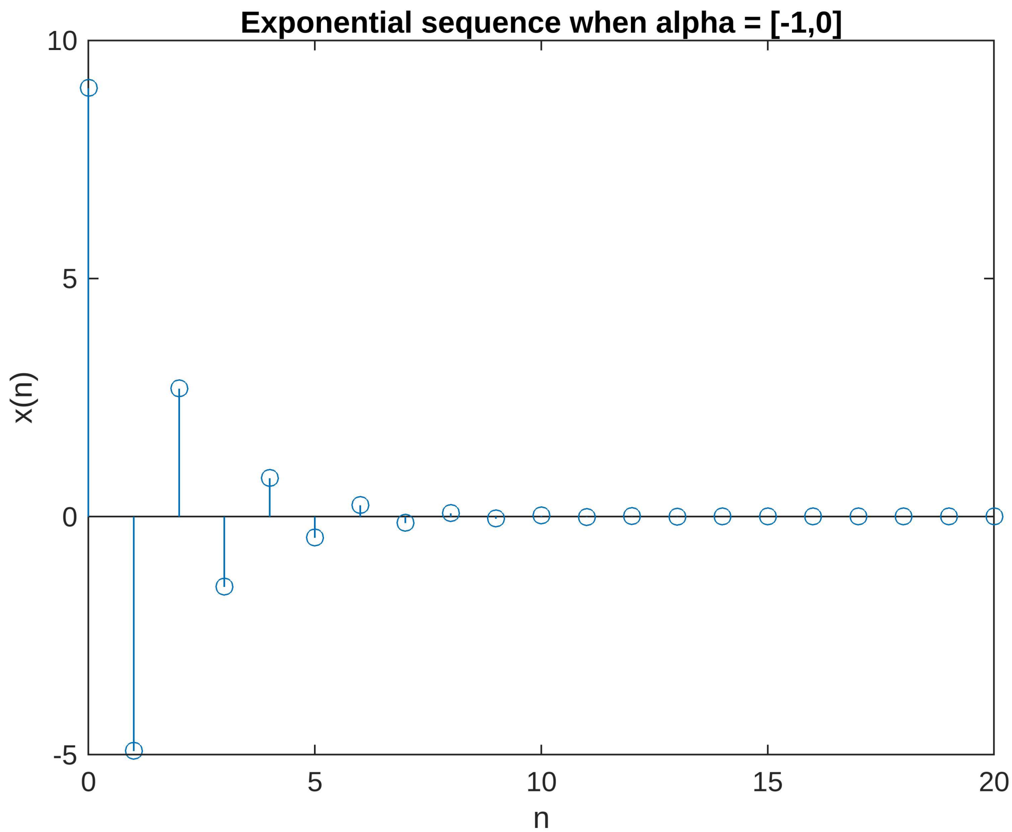
```
% 1st case
alp = rand * 1;
n = 0:1:20;
x_n = A*(alp.^n);
stem(n,x_n);
xlabel('n');
ylabel('x(n)');
title('Exponential sequence when alpha = 1');
```



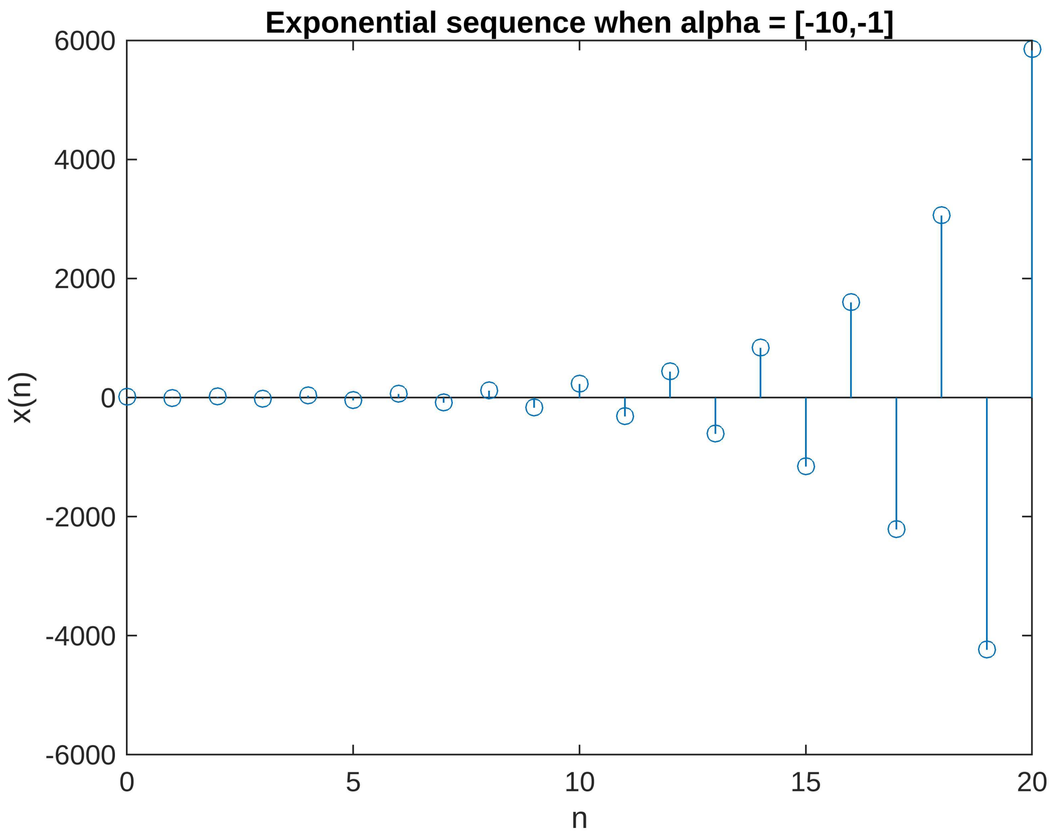

```
% 2nd case
alp = 1 + 10 * rand;
x_n = A*(alp.^n);
stem(n,x_n);
xlabel('n');
ylabel('x(n)');
title('Exponential sequence when alpha = [1,10]');
```




```
%3rd case
alp = rand * -1;
x_n = A*(alp.^n);
stem(n,x_n);
xlabel('n');
ylabel('x(n)');
title('Exponential sequence when alpha = [-1,0]');
```




```
% 4th case
alp = -10 + 9 * rand;
x_n = A*(alp.^n);
stem(n,x_n);
xlabel('n');
ylabel('x(n)');
title('Exponential sequence when alpha = [-10,-1]');
```



C. COMPLEX SINUSOIDS AND EXPONENTIALS

1 Fix an value of `A`

```
A = 9;
```

2 Randomly generate values of W_0 [0,2pi] and phi[-pi,pi].

```
w = rand * 2*pi
```

```
w = 6.0626
```

```
phi = -pi + 2*pi * rand
```

```
phi = -2.1513
```

3 Sketch the real and imaginary parts of the following signal

x[n] = A.alp^n.

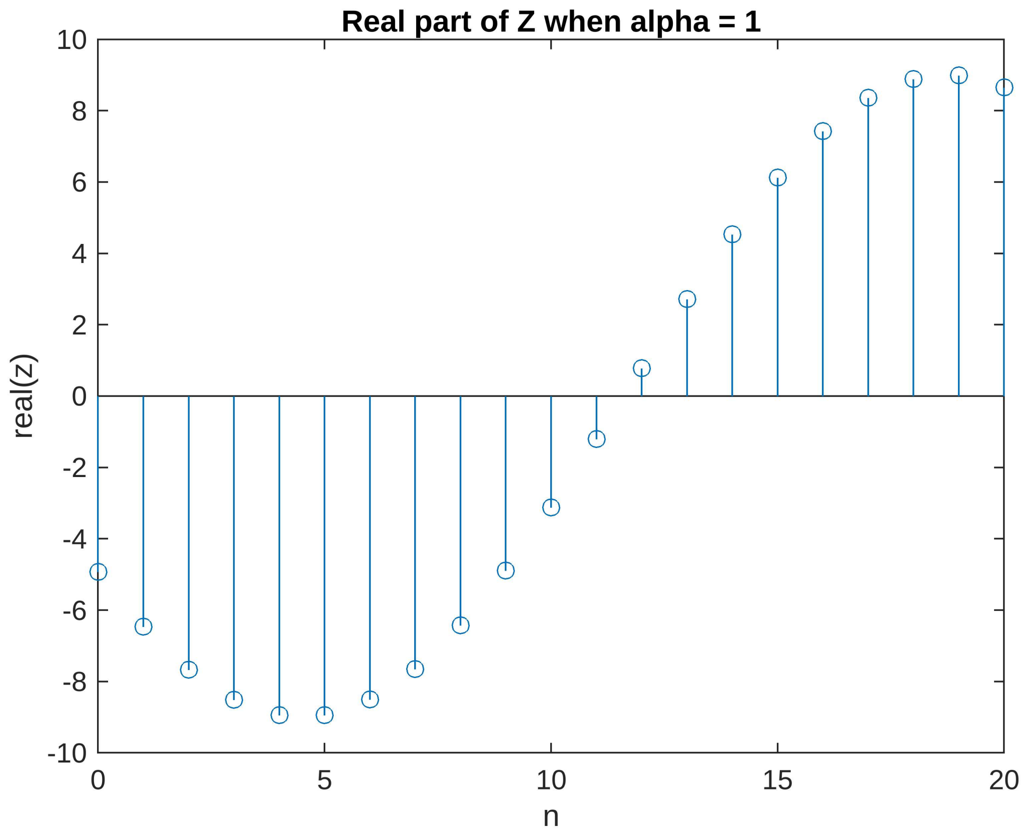
case 1 : `alpha` = 1

```
disp('Complex Exponentials with alpha = 1.');
```

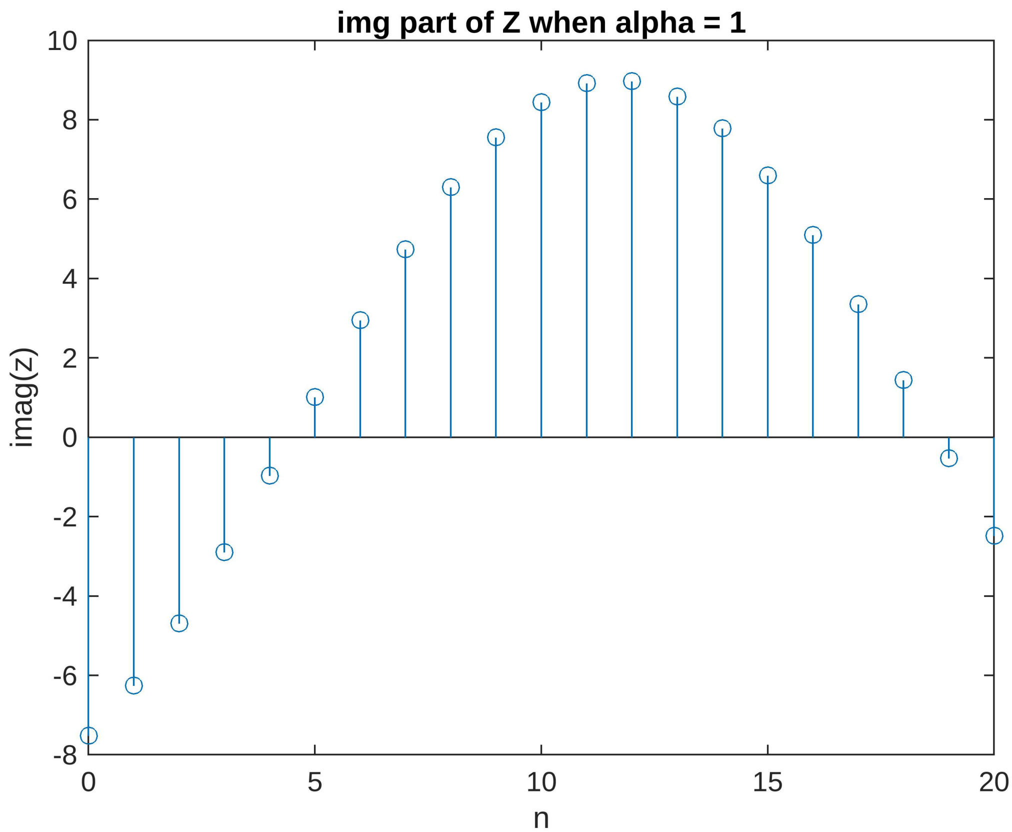
```
Complex Exponentials with alpha = 1.
```

```
alp = 1;
n = 0:1:20;
```

```
z = A * (alp.^n) .* exp(1j * (w * n + phi));
% plotting real part
stem(n,real(z));
xlabel('n');
ylabel('real(z)');
title('Real part of Z when alpha = 1');
```




```
%plotting imag part
stem(n,imag(z));
xlabel('n');
ylabel('imag(z)');
title('img part of Z when alpha = 1');
```

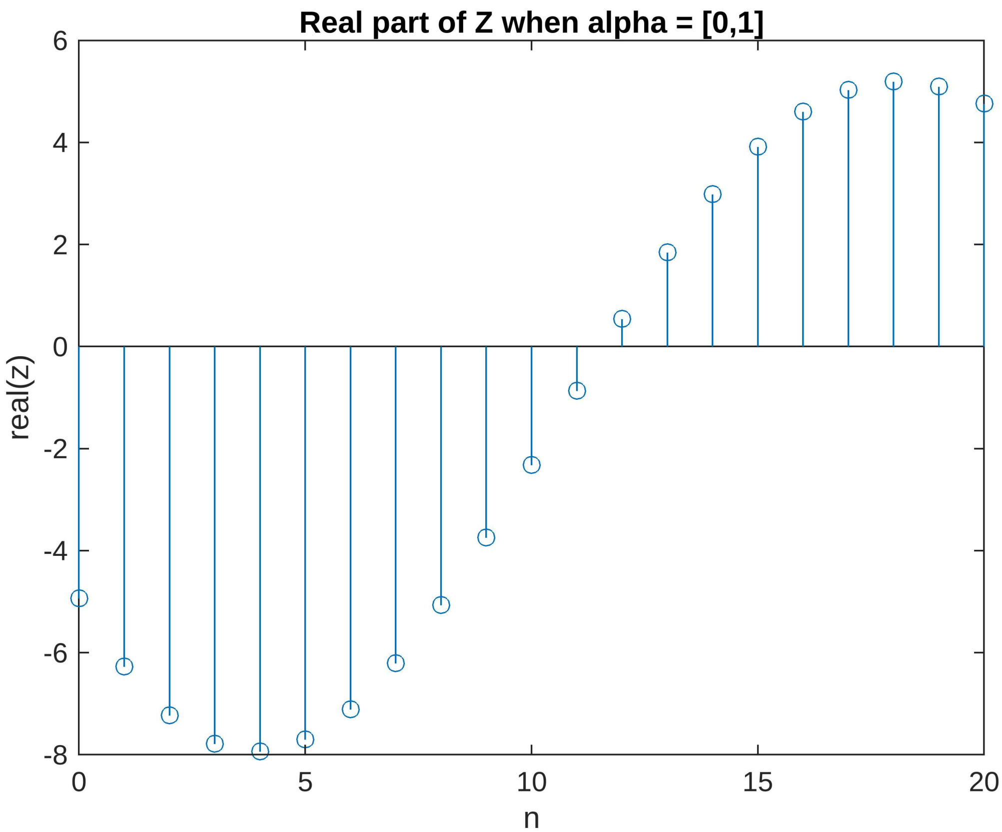


case 2 : alpha = [0,1]

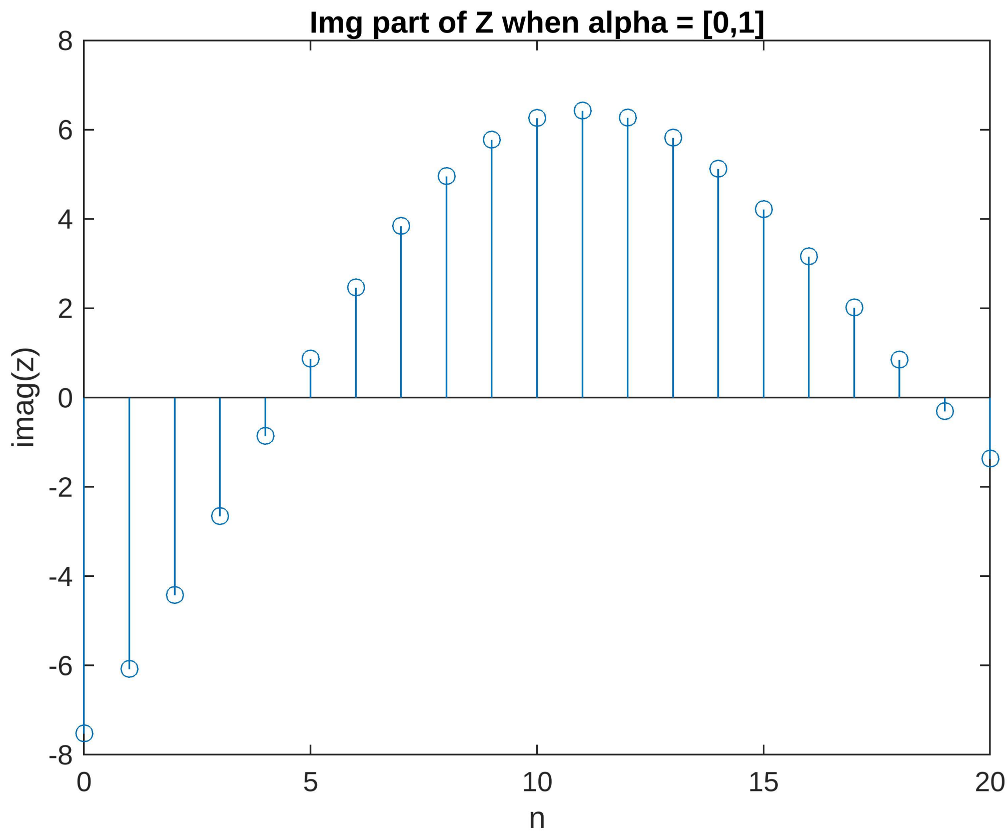
```
disp('Complex Exponentials with alpha = [0,1].');
```

```
Complex Exponentials with alpha = [0,1].
```

```
alp = rand * 1;
n = 0:1:20;
z = A * (alp.^n) .* exp(1j * (w * n + phi));
% plotting real part
stem(n,real(z));
xlabel('n');
ylabel('real(z)');
title('Real part of Z when alpha = [0,1]');
```




```
%plotting imag part
stem(n,imag(z));
xlabel('n');
ylabel('imag(z)');
title('Img part of Z when alpha = [0,1]');
```

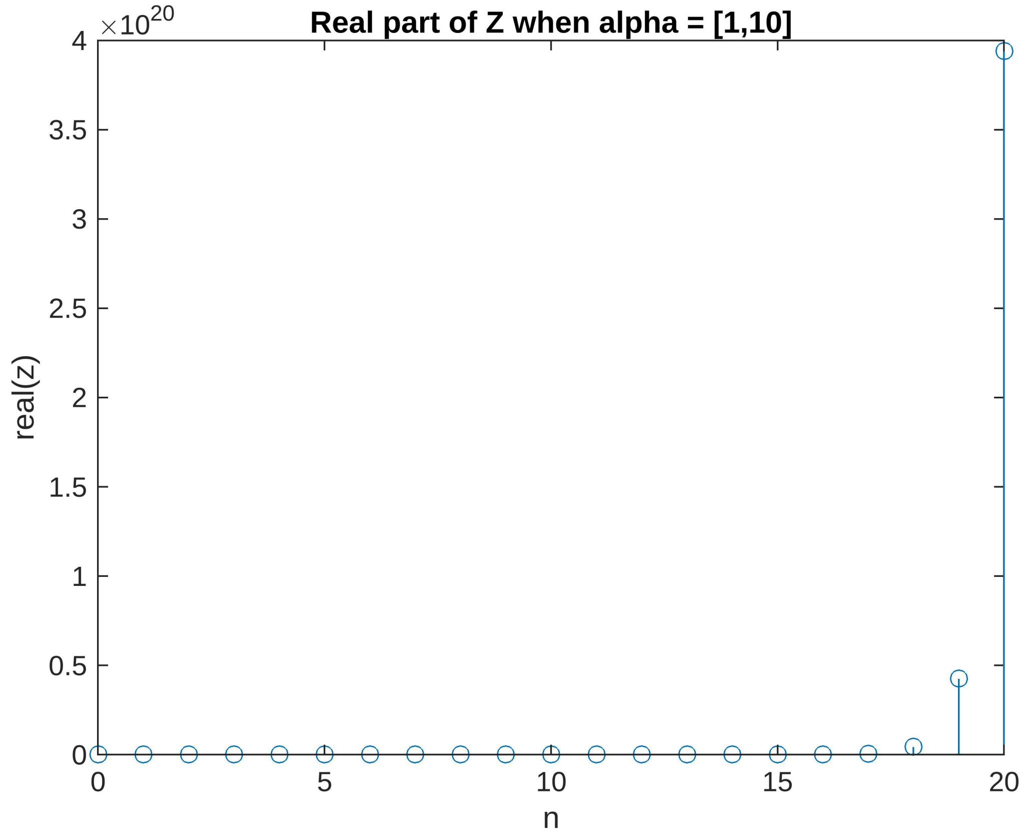


case 3 alpha = [1,10]

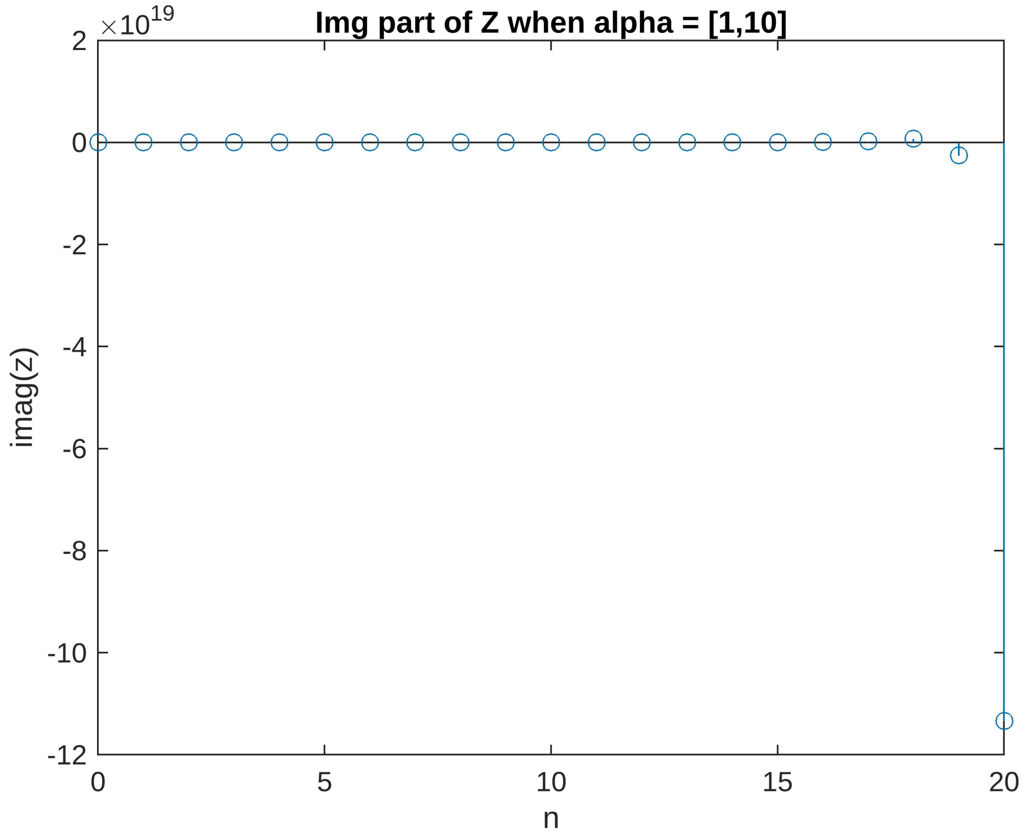
```
disp('Complex Exponentials with alpha = [1,10].');
```

```
Complex Exponentials with alpha = [1,10].
```

```
alp = 1 + 9 * rand;
n = 0:1:20;
z = A * (alp.^n) .* exp(1j * (w * n + phi));
% plotting real part
stem(n,real(z));
xlabel('n');
ylabel('real(z)');
title('Real part of Z when alpha = [1,10]');
```




```
%plotting imag part
stem(n,imag(z));
xlabel('n');
ylabel('imag(z)');
title('Img part of Z when alpha = [1,10]');
```


Img part of Z when alpha = [1,10]
×10^19
2
0
-2
-4
-6
-8
-10
-12
imag(z)
0
5
10
15
20
n