EE451_Homework1_Jacklin

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9/2/2023

Problem 1

please note that for each of the pieces of problem 1, the equations will be numbered, while the items to determine will be lettered. Also note that since so much of the work is performed in the command window, for recording perposes, I have choosen to place command line inputs within text format, and items that can be programmed through the .m file within the text sector.

note that n comes from Problem 2

```
n = -5:1:5;
```

problem 1.1

equation: x1(n) = 5delta(n+1) + 10delta(n-3)

using impseq.m,sigshift.m and sigadd.m this equation is inputted

The following lines were written into the command line, note that n given

from Problem 2 which will be plotted later is used as the reference values

for this.

[x1a, n] = impseq(-1, -5,5);

x1a [0 0 0 0 1 0 0 0 0 0 0]

[x1b, n] = impseq(3, -5,5);

x1b [0 0 0 0 0 0 0 0 1 0 0]

with this done, sigadd.m function can be used in the command window as

well

[x1, n] = sigadd (x1a, n, x1b, n)

x1 [0 0 0 0 1 0 0 0 1 0 0]

Part a: Length

Since there are only two values in which the signals value is greater than zero, the length of this signal is finite, thus n2 -n1 +1 will provide the signal length, or 3 - (-1) + 1 = 5 is the length of signal x1.

Part b: Causal/Anti-causal/Non-Causal

Since x1 is not zero for all negative or positive values, this is a

non-causal. Please view Problem 2.1 to view the figure that confirms this.

Part c: Energy (using energy.m)

just as in the setup, within the command window I use energy.m function to

determine the power over the range n

[p11] = energy (x1, n)

p11 = 2

Part d: Period and is it periodic?

Since delta functions only equal 1 at a single instance during each delta

function, this function is not periodic and thus, does not have a period.

problem 1.2

Equation: x2(n) = u(n+3) - u(n-3)

using stepseq.m, sigshift.m, and sigsub.m

In the Command window:

[x2a, n] = stepseq(-3, -5, 5)

x2a [0 0 1 1 1 1 1 1 1 1 1]

[x2b, n] = stepseq(3, -5, 5)

x2b [0 0 0 0 0 0 0 0 1 1 1]

this gives us the first and second half of x2. Now to add

[x2, n] = sigadd (x2a, n, x2b, n)

x2 [0 0 1 1 1 1 1 1 2 2 2]

Part a: Length

When n is greater than zero, all values of the signal are greater than zero, but this is not true for the negative side of the signal, so the signals length is defined by the length of n2 - n1 +1 which provides us 3 - (-3) + 1 = 7 for the x2 signal length.

Part b: Causal/Anti-causal/Non-Causal

Since x2 is not zero for all negative or positive values, this is a

non-causal. Please view Problem 2.2 to view the figure that confirms this.

Part c: Energy (using energy.m)

in the command window using energy.m

[p2] = energy (x2, n)

p2 = 18

Part d: Period and is it periodic?

since a step function is 1 from the offset value or more generally, zero,

there is no pattern to the result shown in figure 2, this this function is

not periodic.

problem 1.3

equation: x3(n) = 0.5.^n * u(n)

using stepseq.m, sigmult.m

in command window:

x3a = 0.5.^n;

x3a [32.0000 16.0000 8.0000 4.0000 2.0000 1.0000 0.5000 0.2500 0.1250 0.0625 0.0312]

[x3b, n] = stepseq(0,-5, 5)

x3b [0 0 0 0 0 1 1 1 1 1 1]

now to combined them using sigmult.m in command window

[x3, n] = sigmult(x3a, n, x3b, n)

x3 [0 0 0 0 0 1.0000 0.5000 0.2500 0.1250 0.0625 0.0312]

Part a: Length

Since the two signals have x(n) that are equal to zero, only when n is less than zero, this signal is infinite.

Part b: Causal/Anti-causal/Non-Causal

since the function x3 is zero until n = 0, this function is thus causal.

Part c: Energy (using energy.m)

in command window energy.m is used on x3

[p3] = energy (x3, n)

p3 = 1.3330

Part d: Period and is it periodic?

there is no patern in this function, and this is an exponential function

past n = 0 thus, this function is not periodic.

problem 1.4

equation: x4(n) = 2.^n * u(n)

using stepseq.m, sigmult.m

x4a = 2.^n

x4a [0.0312 0.0625 0.1250 0.2500 0.5000 1.0000 2.0000 4.0000 8.0000 16.0000 32.0000]

[x4b, n] = stepseq(0,-5, 5)

x4b [0 0 0 0 0 1 1 1 1 1 1]

[x4, n] = sigadd(x4a, n, x4b, n)

x4 [0.0312 0.0625 0.1250 0.2500 0.5000 2.0000 3.0000 5.0000 9.0000 17.0000 33.0000]

Part a: Length

Once again, since there is no value x(n) that is equal or less than zero, this signal is infinite.

Part b: Causal/Anti-causal/Non-Causal

since this signal begins at n = -1, and n less than -1 equals zero,

although only off by a single point, results in a non-causal signal.

Part c: Energy (using energy.m)

in command window energy.m is used on x4

[p4] = energy (x4, n)

p4 = 1.4973e+03

Part d: Period and is it periodic?

since this function is exponential, this is non periodic.

problem 1.5

equation: x5(n) = 10*cos[2pin + pi/3] + 5sin[2pin]

using sigadd.m, and the cos and sin functions built into MATLAB

x5a = 10.*cos(2*pi*n + pi/3);

x5a [5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000]

x5b = 5.* sin(2*pi*n);

x5b [0.6123 0.4899 0.3674 0.2449 0.1225 0 -0.1225 -0.2449 -0.3674 -0.4899 -0.6123]

[x5, n] = sigadd(x5a, n, x5b, n)

x5 [5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000 5.0000]

Part a: Length

Since all values are x(n) > 0 the signal x5 is infinite.

Part b: Causal/Anti-causal/Non-Causal

just as the rest, this signal is non-causal as it does not change to be

zero at any point within the signal.

Part c: Energy (using energy.m)

[p5] = energy (x5, n)

p5 = 275.0000

Part d: Period and is it periodic?

since this function includes sin and cos this signal is periodic with a

period of pi.

problem 1.6

equation: x6(n) = 5*exp[jpin + pi/6]

using exponent built into MATLAB

x6 = 5*exp(j*pi*n + pi/6);

x6 [-8.4405 - 0.0000i 8.4405 + 0.0000i -8.4405 - 0.0000i 8.4405 + 0.0000i -8.4405 - 0.0000i 8.4405 + 0.0000i -8.4405 + 0.0000i 8.4405 - 0.0000i -8.4405 + 0.0000i 8.4405 - 0.0000i -8.4405 + 0.0000i]

notice how there is an imaginary value for each of these items.

Part a: Length

Since values of x(n) are less than zero, the length of this signal is finite, thus -8.4405 - 8.4405 + 1 = 15.881 as the length of x6.

Part b: Causal/Anti-causal/Non-Causal

Since this signal is neither zero for n less than zero, or n greater than zero, this signal is non causal.

Part c: Energy (using energy.m)

[p6] = energy (x6, n)

p5 = 7.8365e+02 - 3.7865e-29i

Part d: Period and is it periodic?

Note that x6 is built of imaginary and real parts, thus, if we consider real(x6) using matlab to determine the real values we can see the real part and find the period from here, which should be pi.

x6d = real(x6);

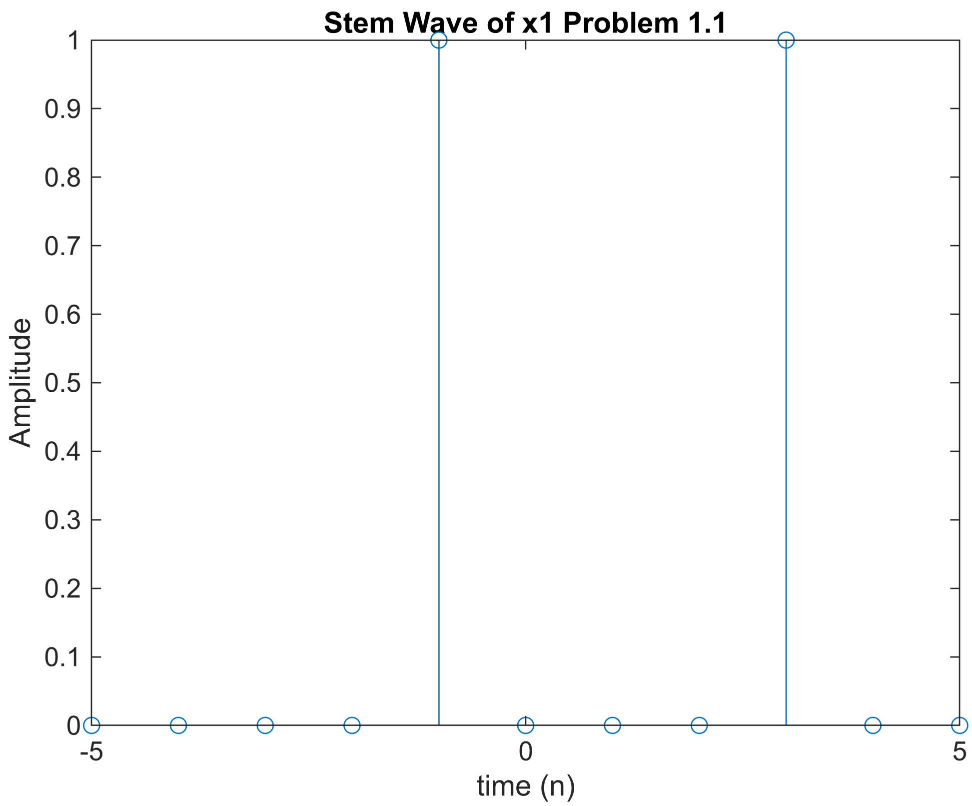
stem(x6d)

Problem 2: plot the signals in part 1 given n = -5...5

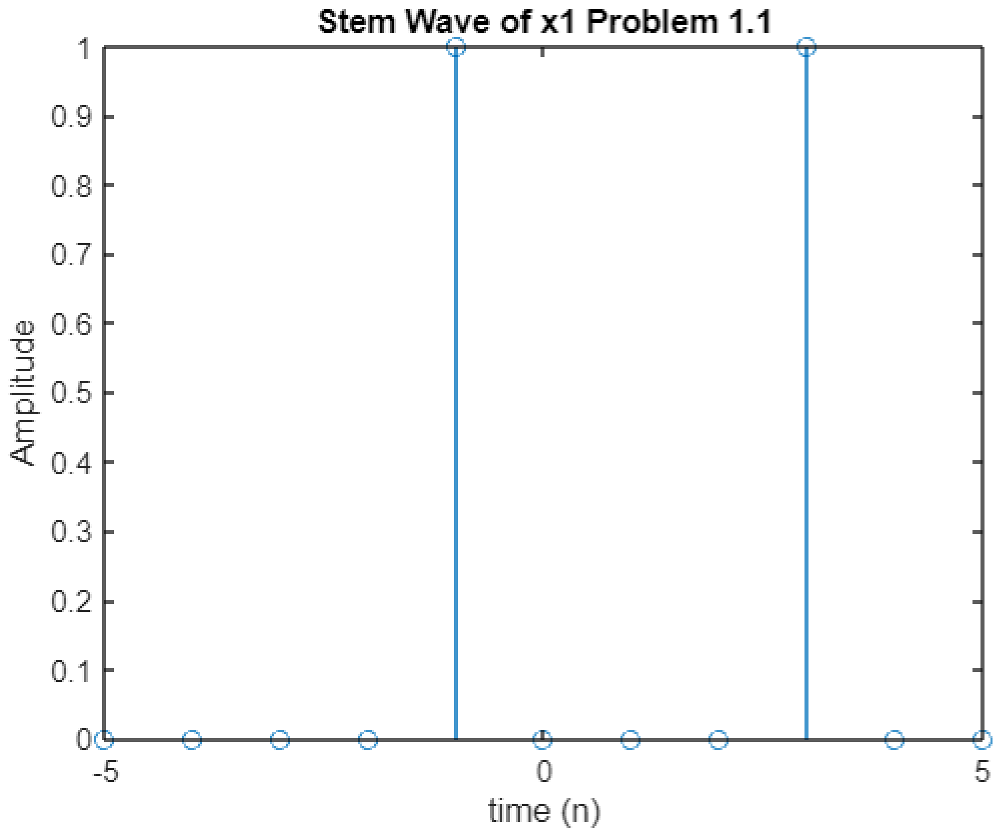
note that this range for n is used to provide answers to problem 1 as well. Note that the n range writen above with Problem 1 for values to compute with the functions built.

```
% %Problem 2.1
```

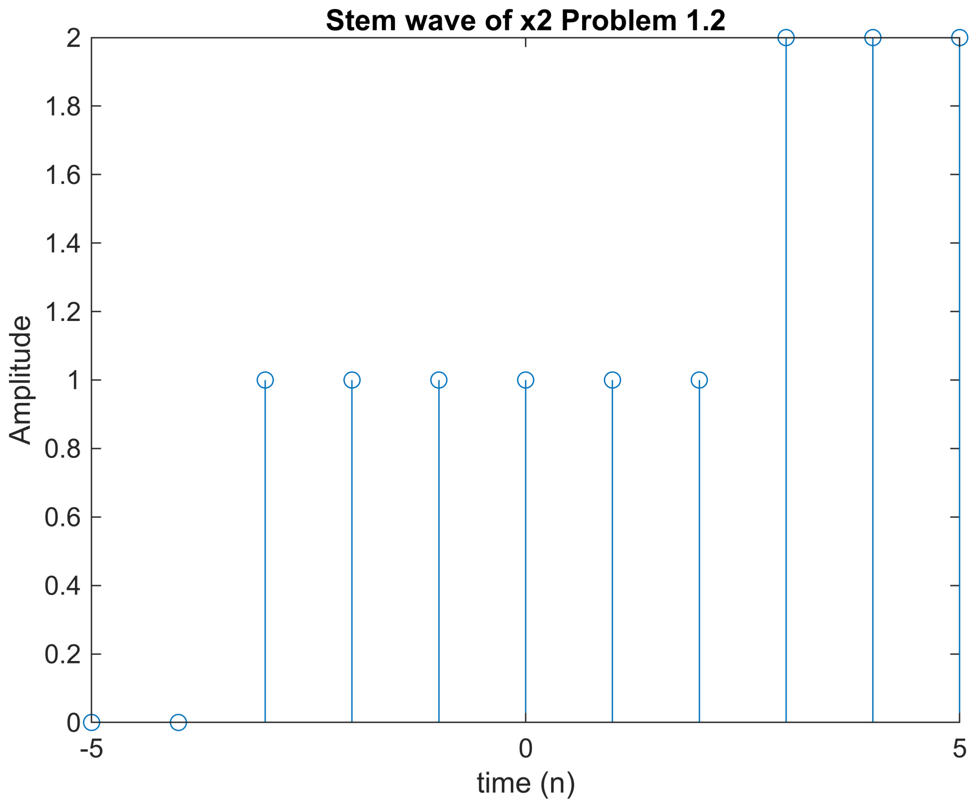
```
figure; stem(n, x1);
xlabel('time (n)'); ylabel("Amplitude")
title('Stem Wave of x1 Problem 1.1')
```



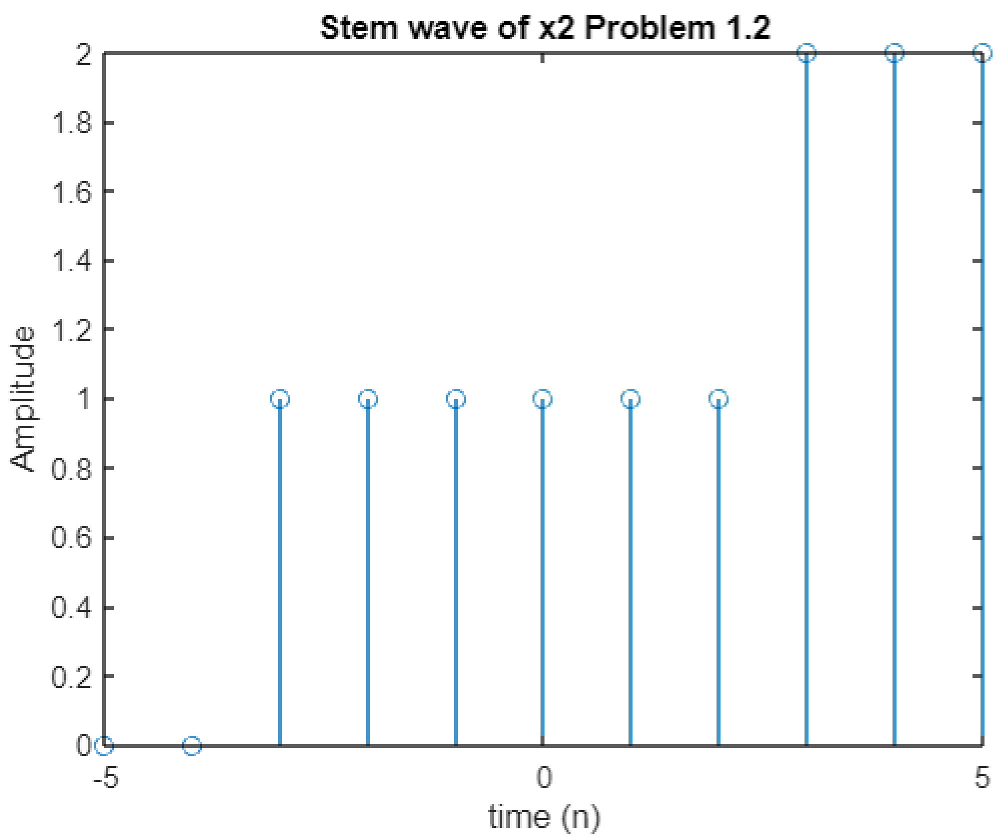

```
%
```



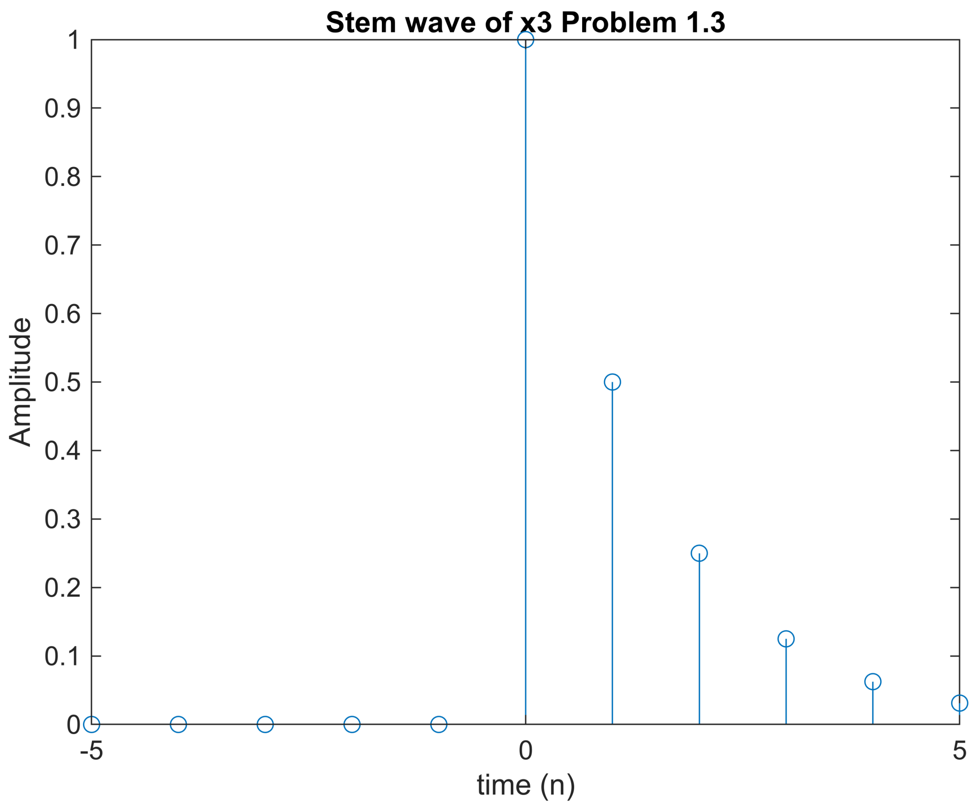

```
% %Problem 2.2
figure; stem(n, x2);
xlabel('time (n)'); ylabel("Amplitude");
title('Stem wave of x2 Problem 1.2')
```


Stem wave of x2 Problem 1.2
Amplitude
time (n)

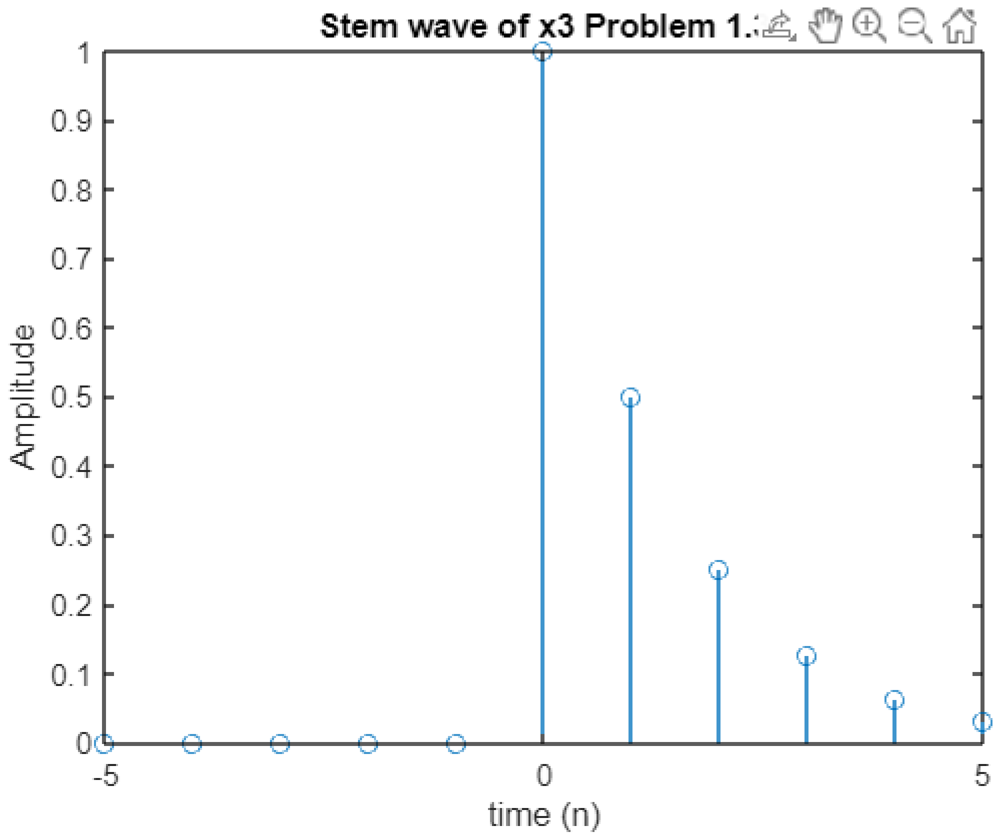

```
%
```


Stem wave of x2 Problem 1.2
Amplitude
time (n)

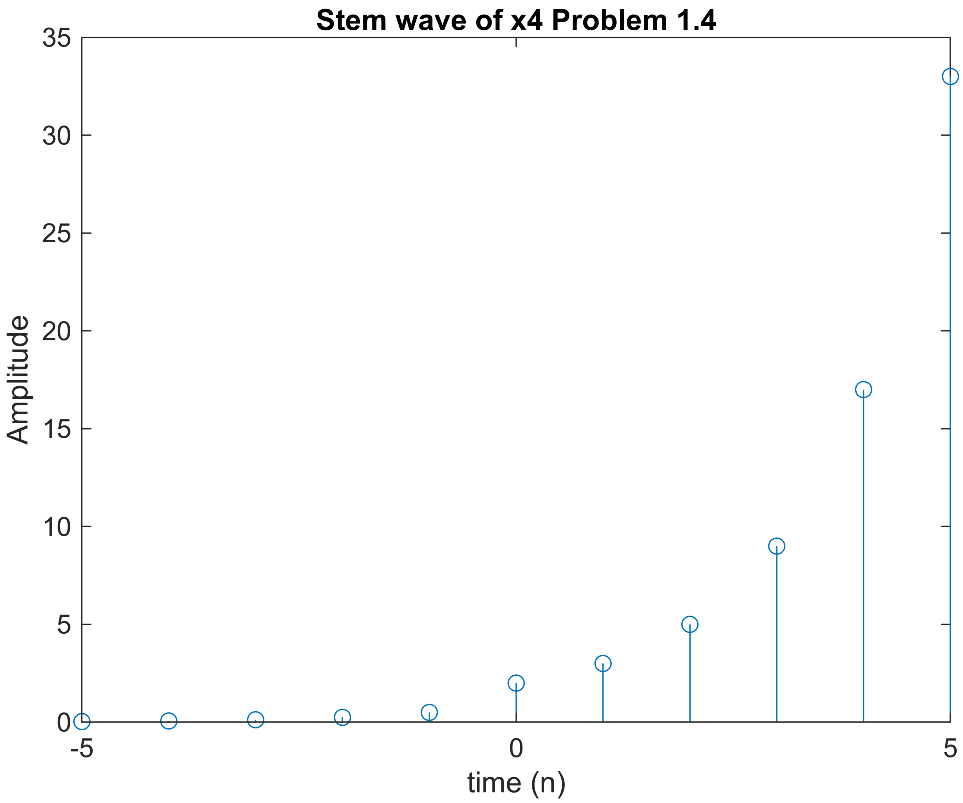
```
% %Problem 2.3
figure; stem(n, x3);
xlabel('time (n)'); ylabel("Amplitude");
title('Stem wave of x3 Problem 1.3')
```



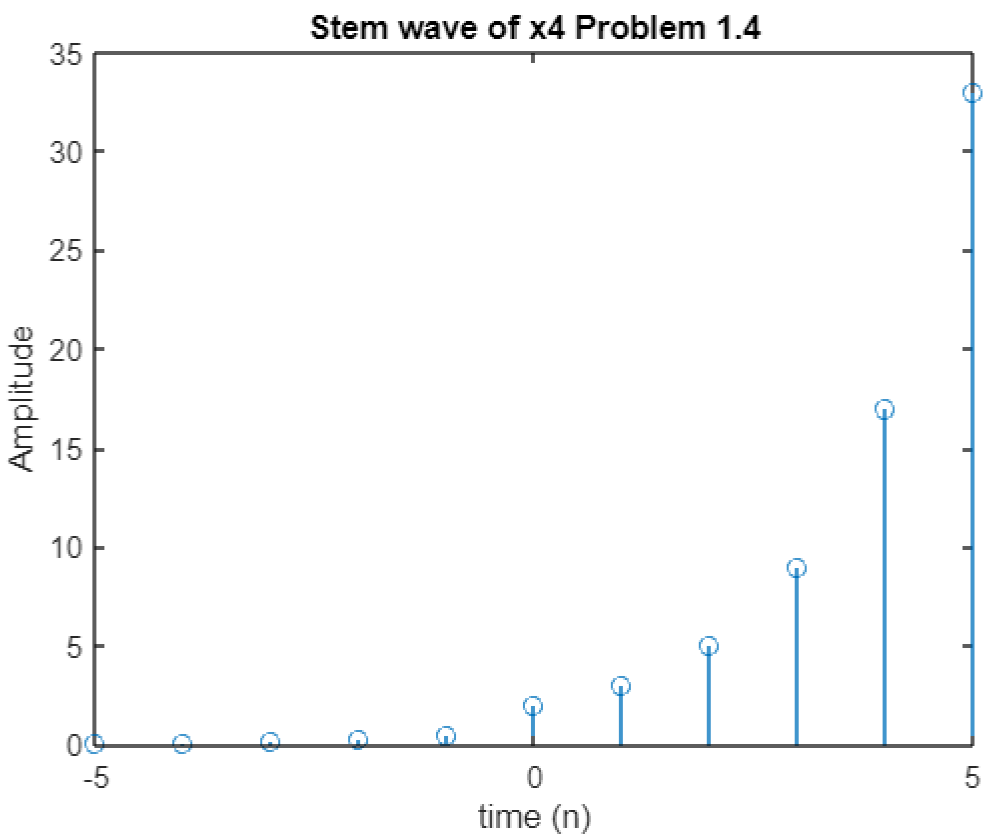

```
%
```



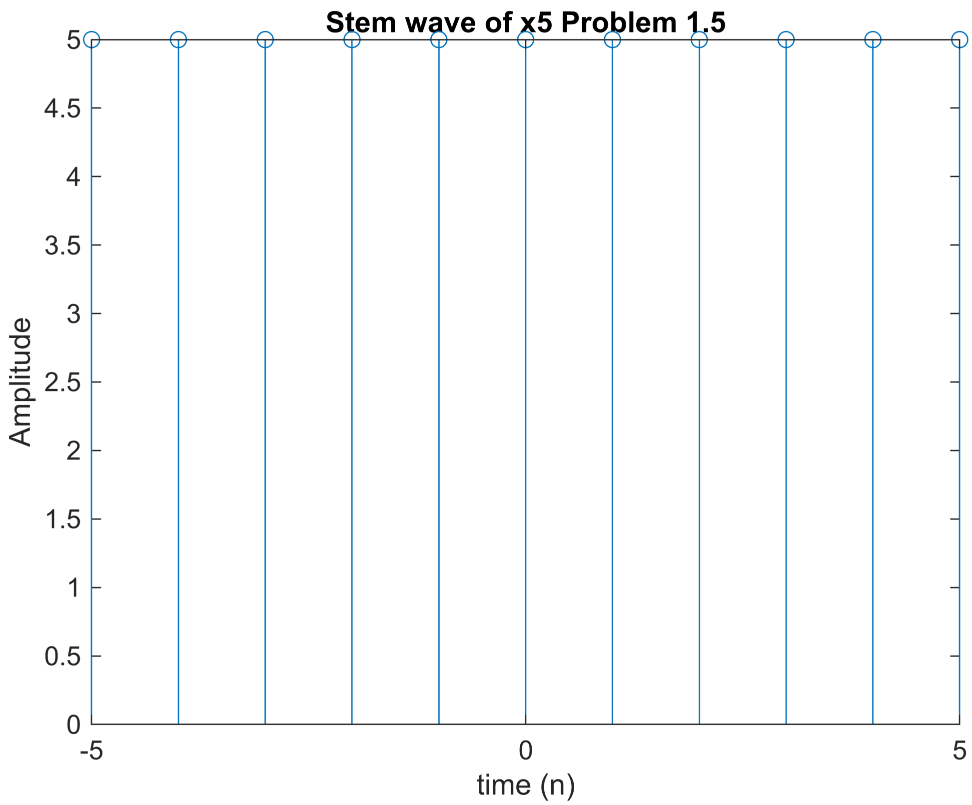

```
% %Problem 2.4
figure; stem(n, x4);
xlabel('time (n)'); ylabel("Amplitude");
title('Stem wave of x4 Problem 1.4')
```


Stem wave of x4 Problem 1.4
Amplitude
time (n)
35
30
25
20
15
10
5
0
-5
0
5

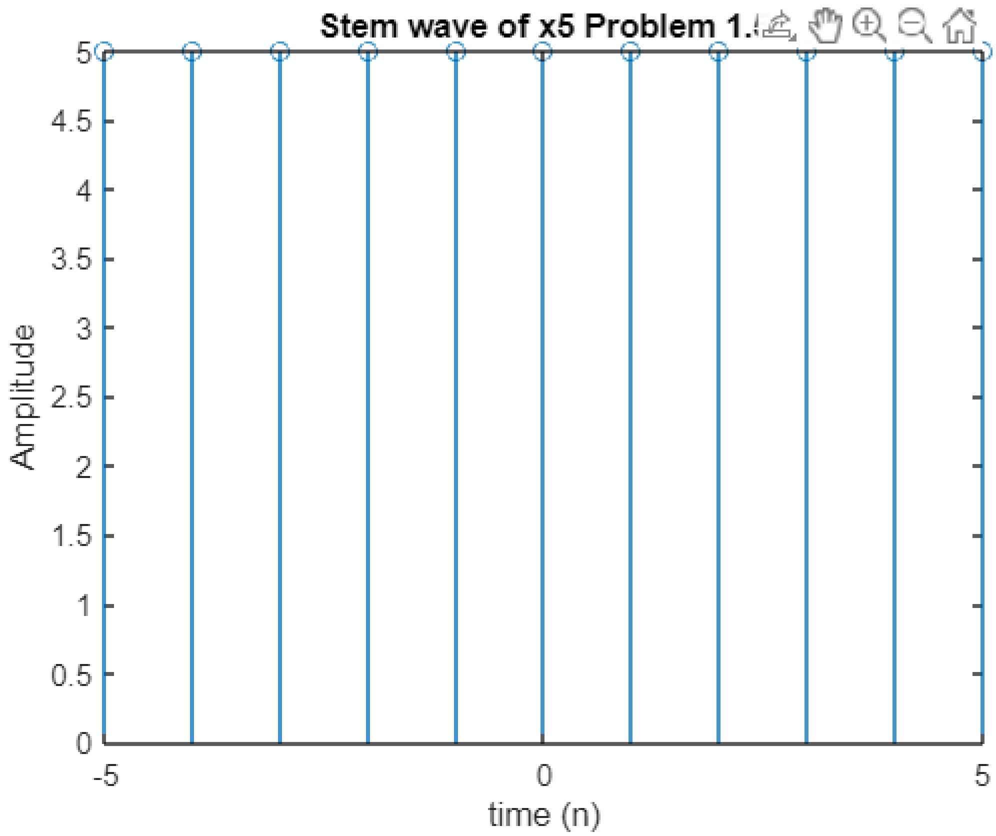
```
%
```


Stem wave of x4 Problem 1.4
Amplitude
time (n)
35
30
25
20
15
10
5
0
-5
0
5

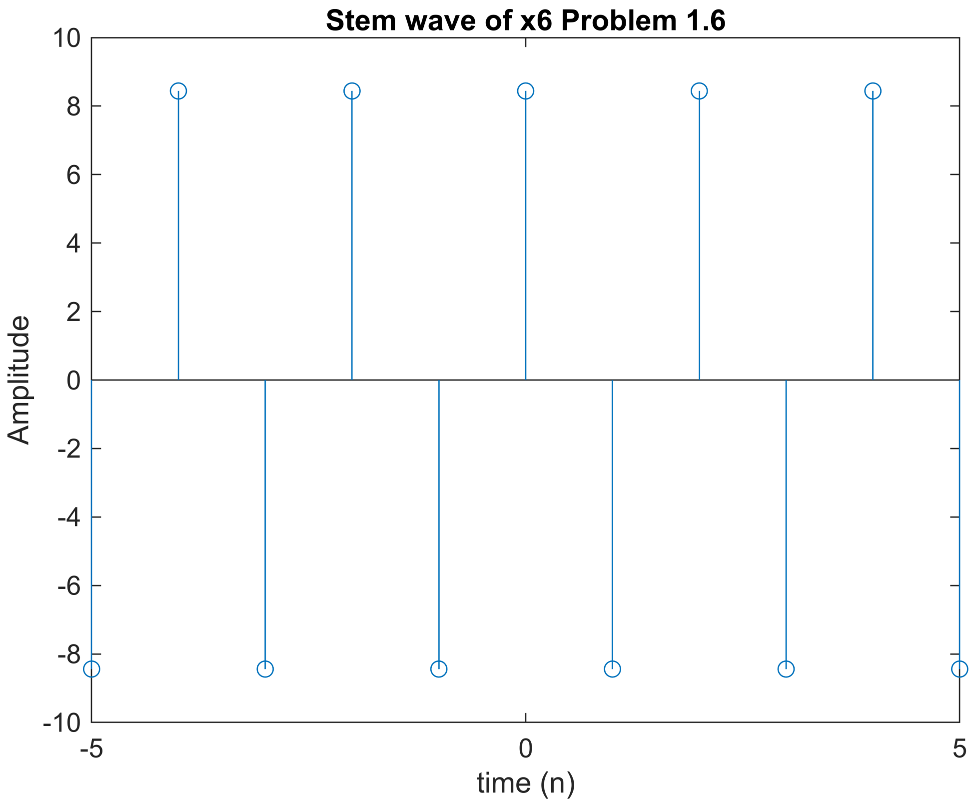
```
% %Problem 2.5
figure; stem(n, x5);
xlabel('time (n)'); ylabel("Amplitude");
title('Stem wave of x5 Problem 1.5')
```

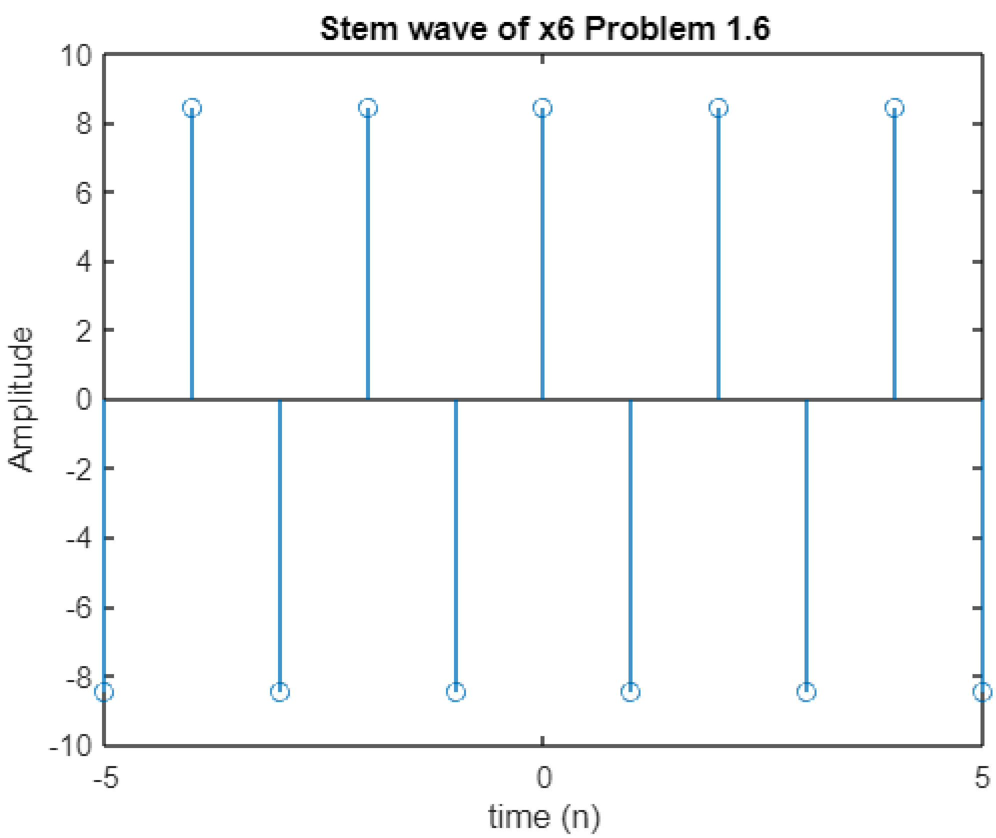



```
%
```




```
%Problem 2.6
figure; stem(n, real(x6));
xlabel('time (n)'); ylabel("Amplitude");
title('Stem wave of x6 Problem 1.6')
```





Problem 3: DSP:P&M 2.1

2.1 A discrete-time signal $x(n)$ is defined as

$$x(n) = \begin{cases} 1 + \frac{n}{3}, & -3 \le n \le -1 \\ 1, & 0 \le n \le 3 \\ 0, & \text{elsewhere} \end{cases}$$

a. Determine its values and sketch the signal $x(n)$.

b. Sketch the signals that result if we:

1. First fold $x(n)$ and then delay the resulting signal by four samples.
2. First delay $x(n)$ by four samples and then fold the resulting signal.

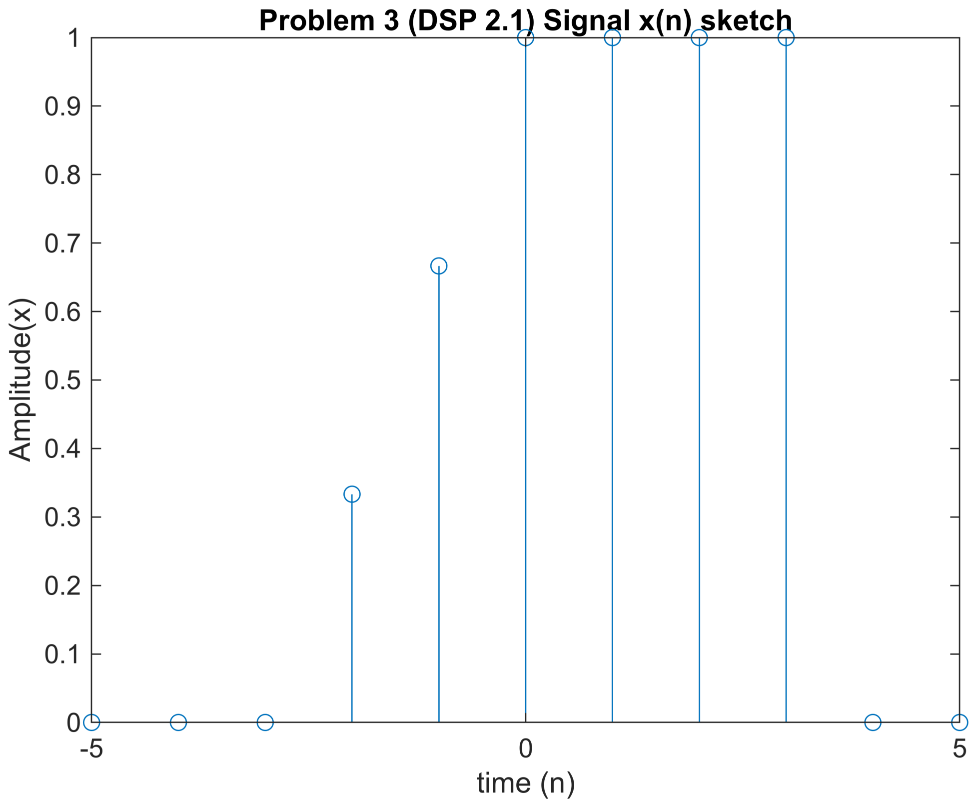
c. Sketch the signal $x(-n+4)$.

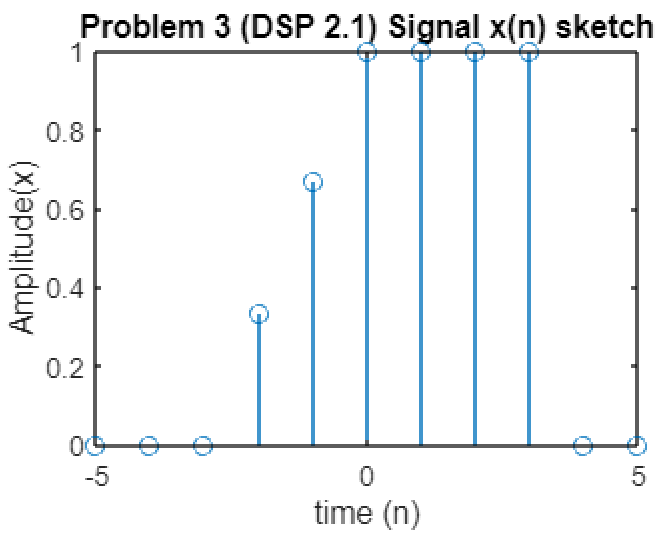
d. Compare the results in parts (b) and (c) and derive a rule for obtaining the signal $x(-n+k)$ from $x(n)$.

e. Can you express the signal $x(n)$ in terms of signals $\delta(n)$ and $u(n)$?

Part a. Determine its values and Sketch the signal x(n)

```
%given the values shown for x(n) in 2.1 n is built
n = -5:1:5; %note that n given in problem 2 works here so now to insert values for x!
x = [0 0 0 0.3333 0.6666 1 1 1 1 0 0 ]; %note that I determined values through basic math and e
figure; stem(n, x);
xlabel("time (n)"); ylabel("Amplitude(x)");
title("Problem 3 (DSP 2.1) Signal x(n) sketch");
```





Part b. Sketch the signal with two different signal adjustments.

b.1: Fold and delay by 4

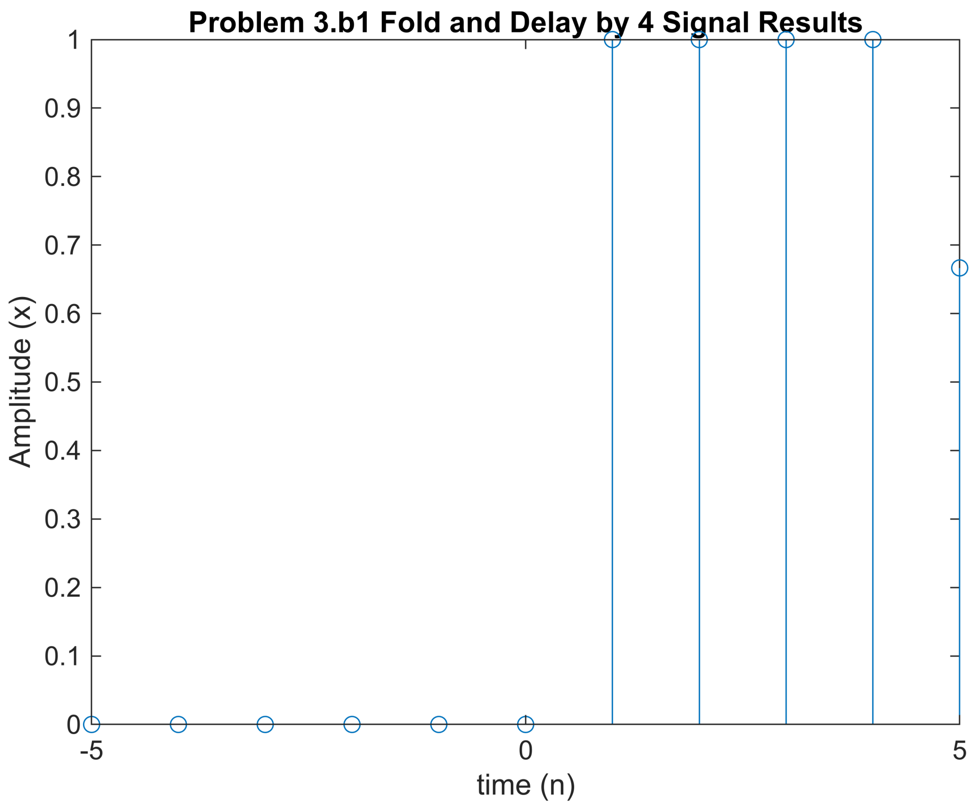
in the command window using sigfold and sigshift.m functions:

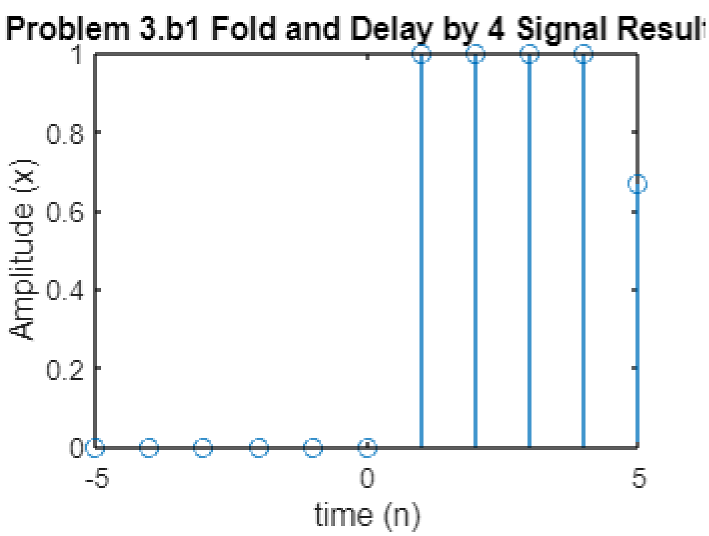
[xb2a, n] = sigfold (x, n);

xb2a [0 0 1.0000 1.0000 1.0000 1.0000 0.6666 0.3333 0 0 0]

[xb2b, nxb] = sigshift(xb2a, n, 4);

```
xb2b = [0 0 0 0 0 0 1.0000 1.0000 1.0000 1.0000 0.6666 ];
figure; stem(n, xb2b);
xlabel('time (n)'); ylabel("Amplitude (x)");
title("Problem 3.b1 Fold and Delay by 4 Signal Results");
```





b.2: Delay by 4 then fold results

in the command window, similar to how performed above, but oposite order:

[xb, n] = sigshift(x, n, 4)

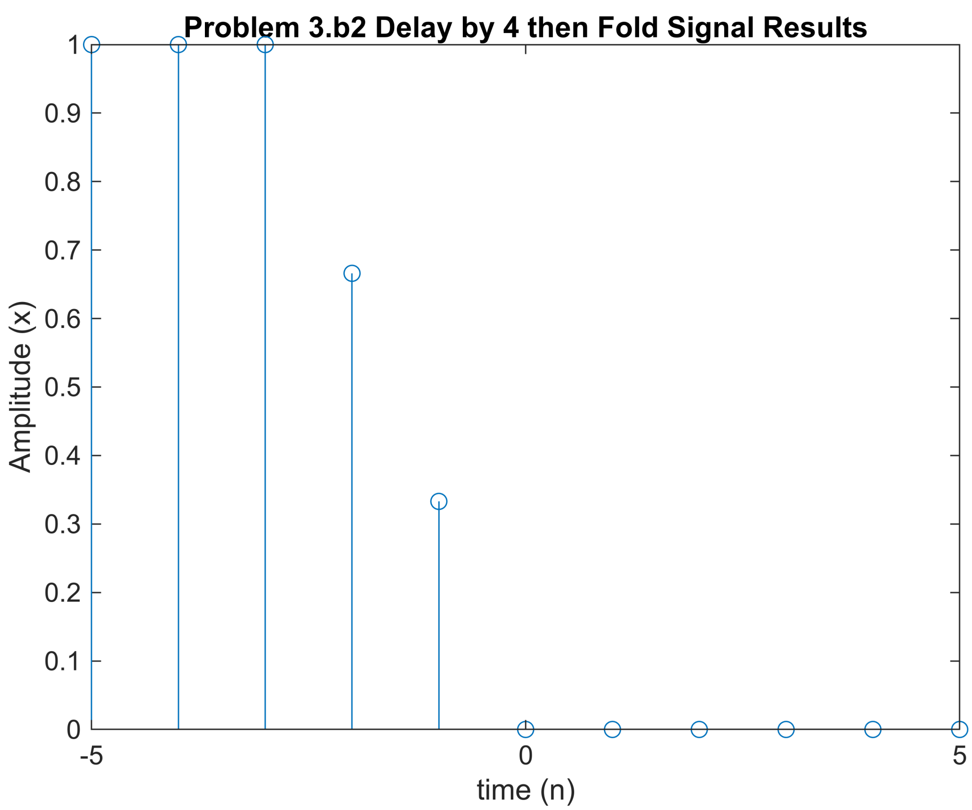
xb = [0 0 0 0 0 0 0.333 0.666 1 1 1]

[xbb2, n] = sigfold (xb, n);

```
xbb2 = [1.0000    1.0000    1.0000    0.6660    0.3330         0         0         0         0
```

```
xbb2 = 1×11
    1.0000    1.0000    1.0000    0.6660    0.3330         0         0         0⋯
```

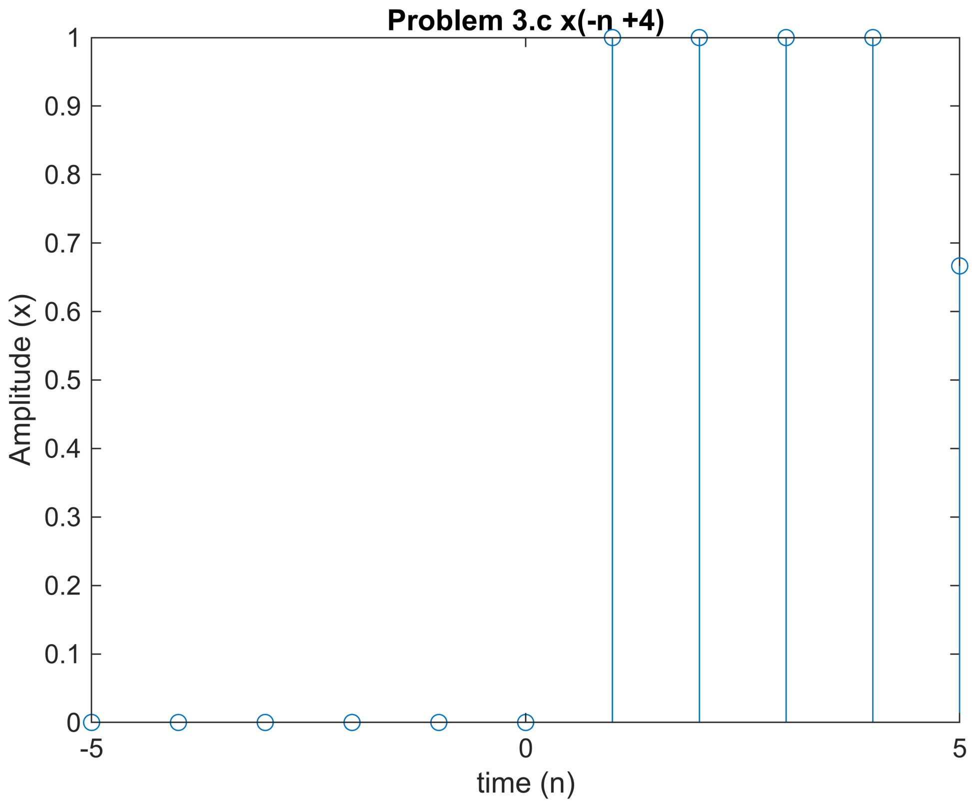
```
figure; stem (n, xbb2);
xlabel('time (n)'); ylabel("Amplitude (x)");
title("Problem 3.b2 Delay by 4 then Fold Signal Results");
```

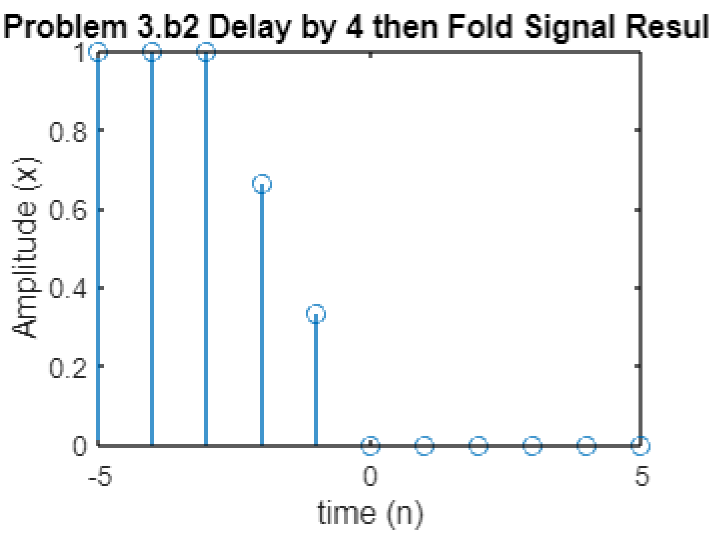


part c.Sketch the signal x(- n + 4)

note that this signal is the same as what was built in part b.1 with the fold creating x(-n) and the shift resulting in x(-n +4);

```
figure; stem(n, xb2b);
xlabel('time (n)'); ylabel("Amplitude (x)");
title("Problem 3.c x(-n +4)");
```





part d. compare the results in parts b and c and derive a rule for obtaining the signal x(-n +k) from x(n)

When comparing the results of part b and c, it becomes obvious that although they are performing the same tasks although different orders, the result is different as seen between part b.2 and part c where the tail end of the signal is displayed while the beginning impulse display is seen in part c.

For this, two rules are created to make this adjustment to the signal, sigfold(x, n) which would give x(-n) and sigshift.m which gives x(n +- k).

Sigfold.m

```
function [y, n] = sigfold (x, n)

% y(n) = x (-n)

% --------------------------

% This flips the index values of n

n = -fliplr(n);

y = fliplr(x);
```

Sigshift.m

```
function [y, n] = sigshift(x, m, k)

% y(n) = x(n + k)

% -------------------

% k is the shifting value

% single signal shift

if k>0

disp('Positive');

n1 = n(1):n(end)+k;

x1 = [zeros(1,k) x];

else

disp('Negative');

n1 = n(1)+k:n(end);

x1 = [x zeros(1,abs(k))]; % abs is for absolute value of (k) because quantity can never be (-ve) negative %

end
```

part e. Can you express the signal x(n) in terms of signals delta(n) and u(n)?

Given the base signal x(n), most spots would result in an impulse or step signal which are labeled as ex1, ex2, etc.

The following is run in the command window.

```
[ex1,n] = stepseq(0 ,0, 3) %gives from 0 to 3

n1 = 0:1:3;

[ex2a, n] = impseq(-2, -5,5) %this is the first pulse higher than n = -3
```

ex2 = 0.333* ex2a;

[ex3a, n] = impseq(-1, -5, 5) %gives the second pulse at n = -1

ex3 = 0.666*ex3a;

%now all these pulses need to be combined

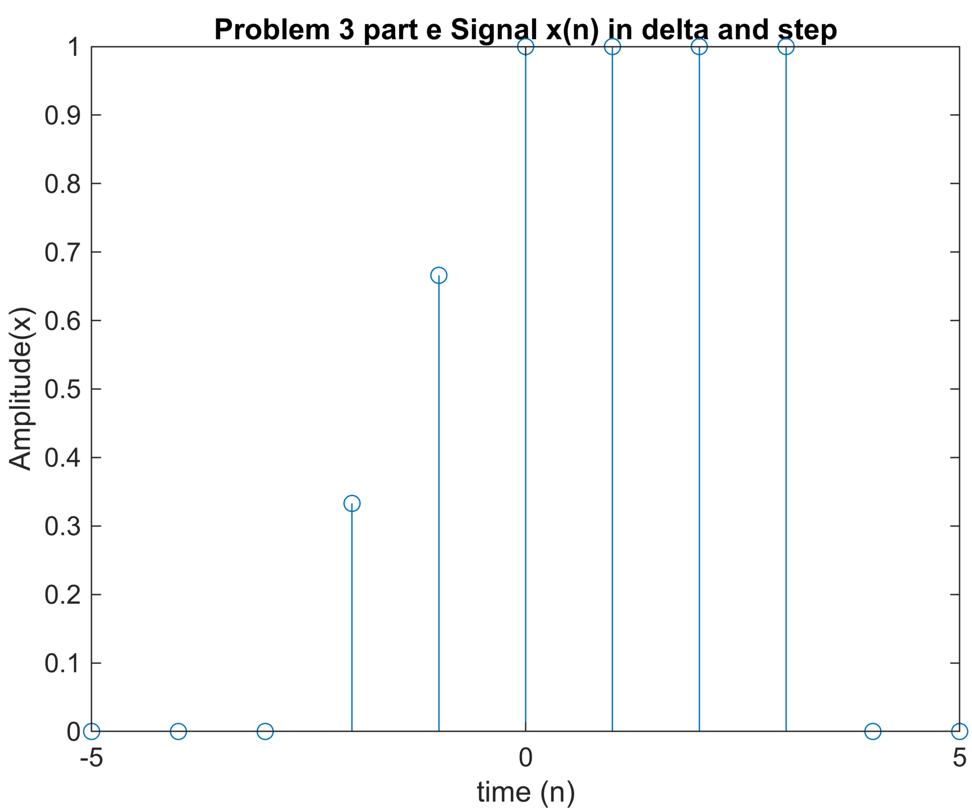
[exa, n] = sigadd(ex1, n1, ex2, n);

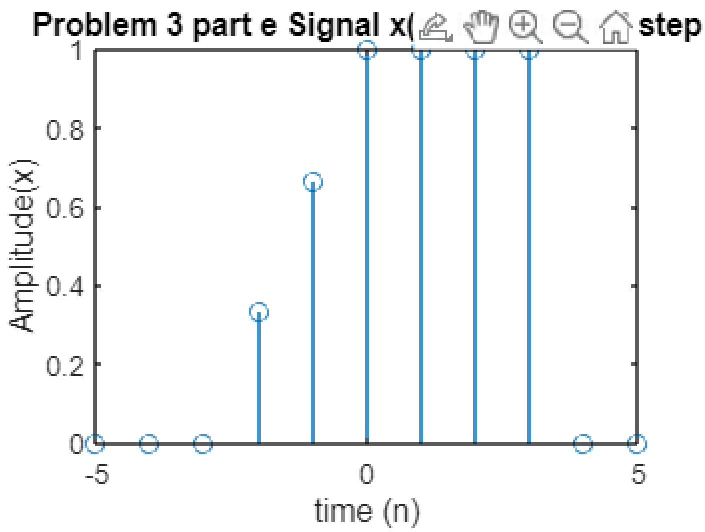
[exb, n] = sigadd(ex3, n, exa, n);

exb = [0 0 0 0.3330 0.6660 1.0000 1.0000 1.0000 1.0000 0 0]

Which, to make sure that this matches as expected, is displayed:

```
exb = [0         0         0    0.3330    0.6660    1.0000    1.0000    1.0000    1.0000
figure; stem(n, exb);
xlabel("time (n)"); ylabel("Amplitude(x)");
title("Problem 3 part e Signal x(n) in delta and step");
```

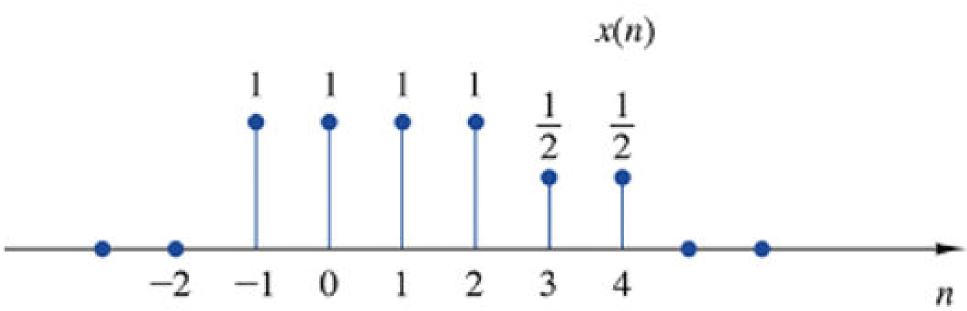




Problem 4: DSP:P&M 2.2

2.2 A discrete-time signal $x(n)$ is shown in Fig. P2.2. Sketch and label carefully each of the following signals.

igure P2.2



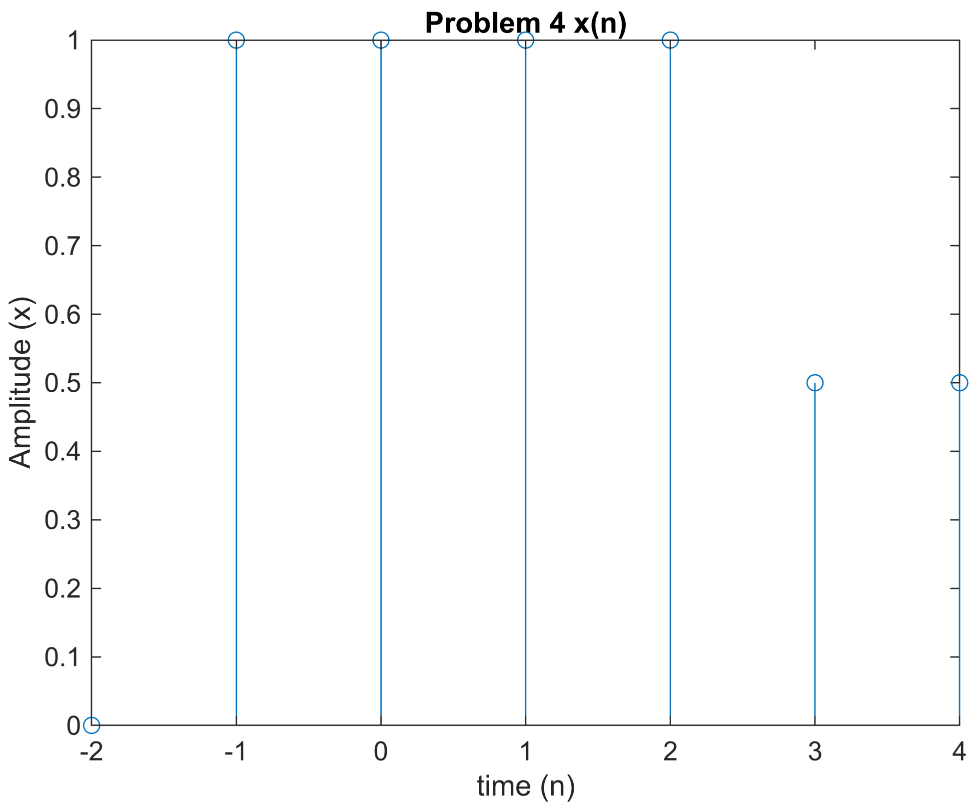
a. $x(n-2)$
b. $x(4-n)$
c. $x(n+2)$
d. $x(n)u(2-n)$
e. $x(n-1)\delta(n-3)$
f. $x(n^2)$
g. even part of $x(n)$
h. odd part of $x(n)$

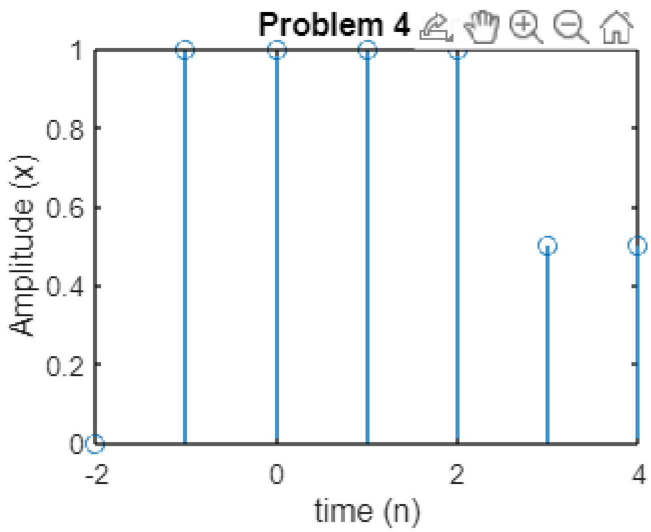
In the command window, the base x(n) function and adjusted n values to match what the figure p2.2 displays.

x22 = [0 1 1 1 1 0.5 0.5];

n22 = -2:1:4;

```
%original x(n) from the problem above for comparisons
n22 = -2:1:4;
x22 = [0 1 1 1 1 0.5 0.5 ];
 figure; stem( n22, x22);
xlabel("time (n)"); ylabel("Amplitude (x)")
title("Problem 4 x(n)")
```

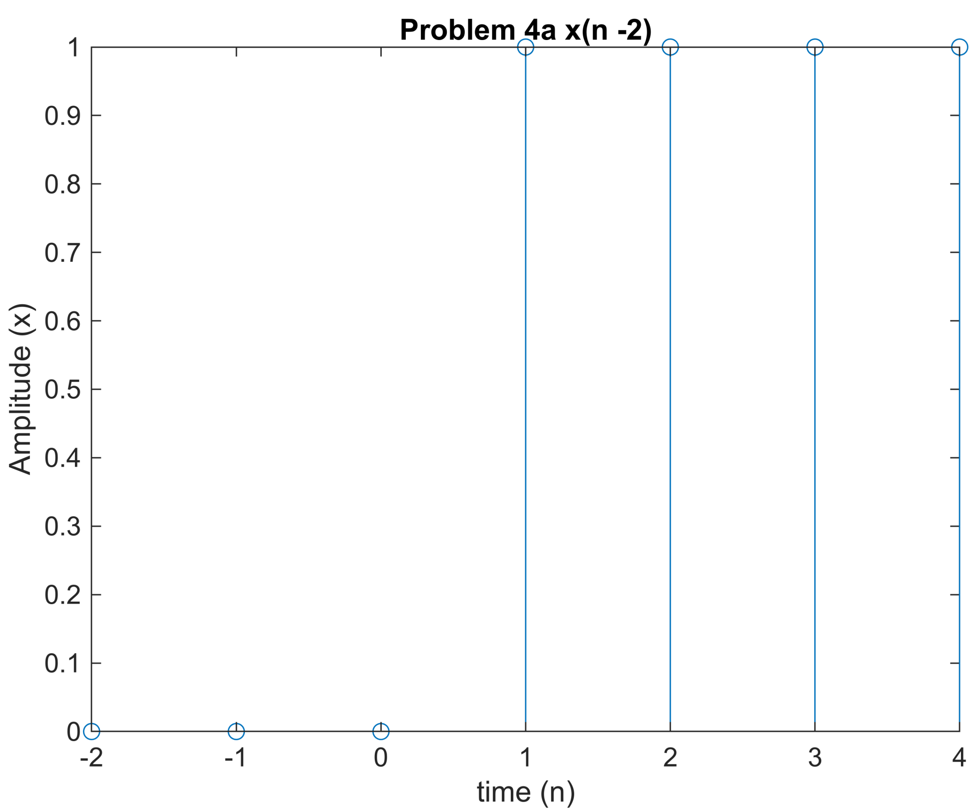


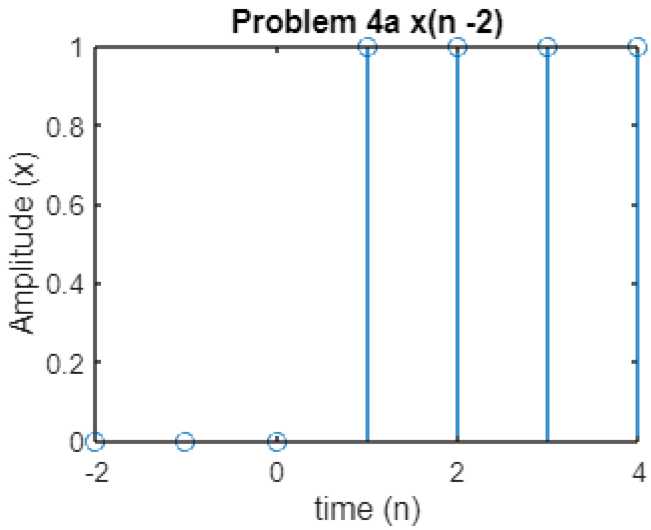


Problem 4.a x(n -2)

[x22a, n22a] = sigshift(x22, n22, 2);

```
x22a = [ 0 0 0 1 1 1 1 ];
figure; stem( n22, x22a);
xlabel("time (n)"); ylabel("Amplitude (x)")
title("Problem 4a x(n -2)")
```





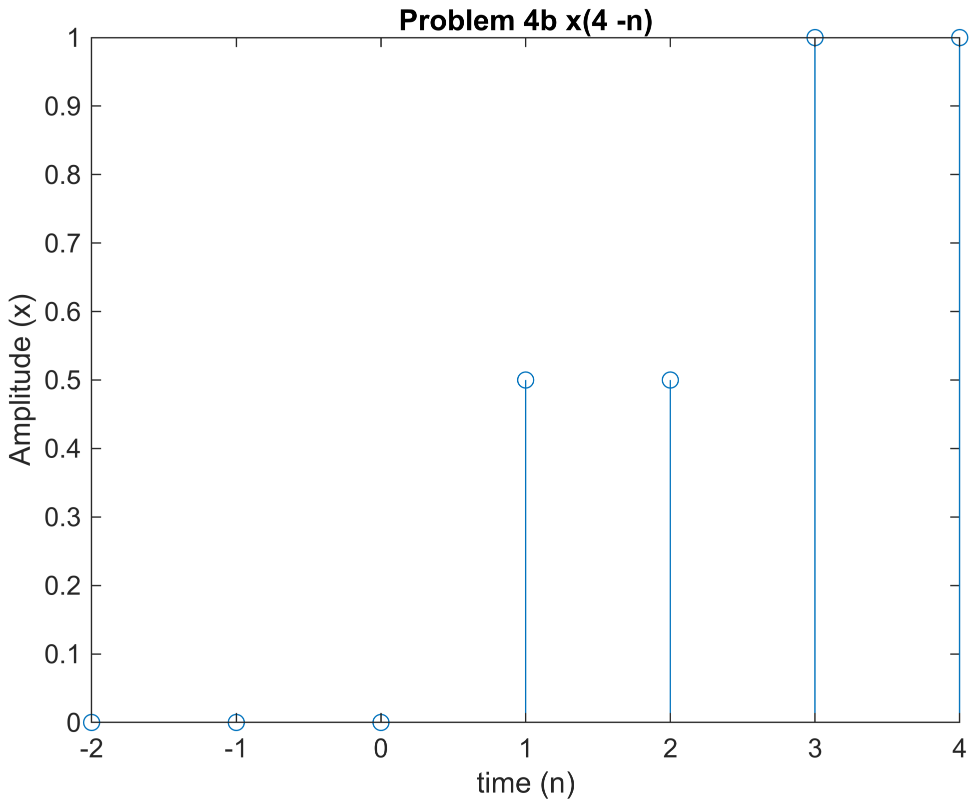
Problem 4.b x(4-n)

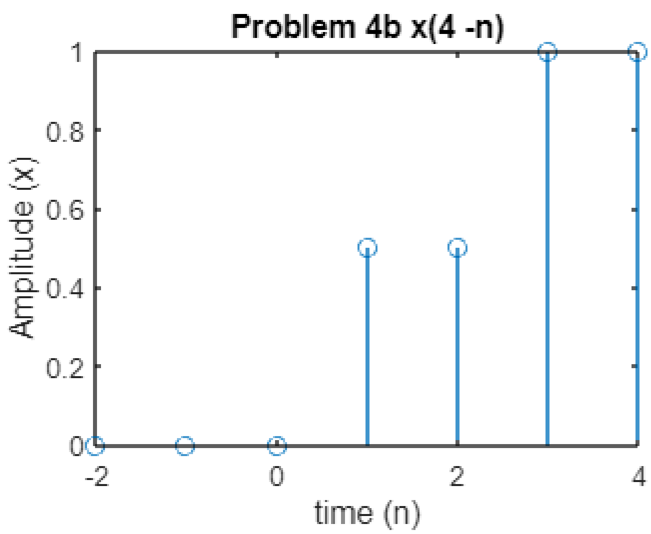
[x22b, n22] = sigshift(x22, n22, 4) % x (4 + n)

x22b = [1 1 0.5 0.5 0 0 0 0]

[x22b, n22] = sigfold (x4b, n);

```
x22b = [         0         0         0    0.5000    0.5000    1.0000    1.0000];
figure; stem(n22, x22b);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4b x(4 -n)");
```

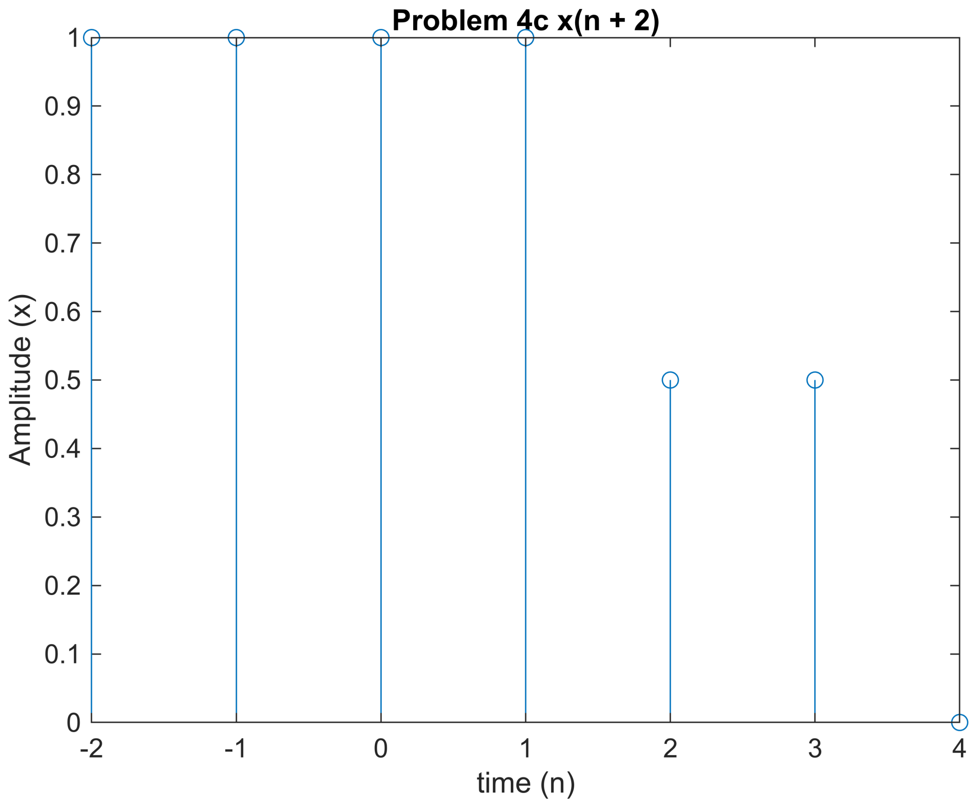


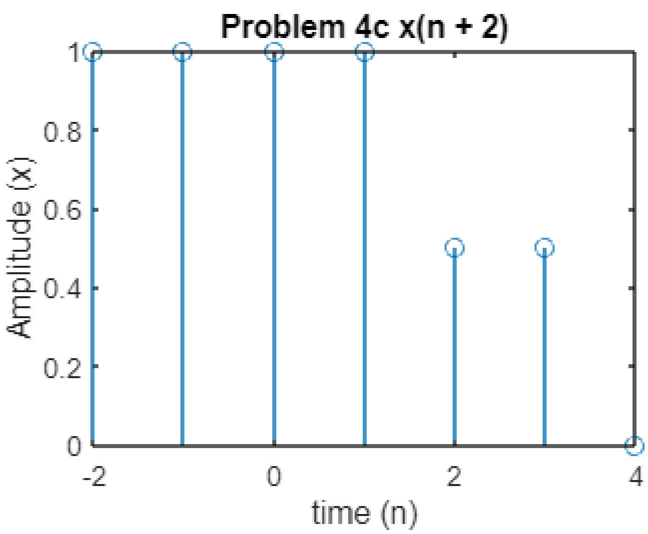


Problem 4.c x(n + 2)

[x22cm n22] = sigshift(x22, n22, -2);

```
x22c = [1 1 1 1 0.5 0.5 0 ];
figure; stem (n22, x22c);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4c x(n + 2)");
```





Problem 4.d x(n) * u(2-n)

[x22d4, n] = stepseq(2,4, 4); %note that this needs to be folded as well to get 2-n

x22d4 = [0 0 0 1 1 1 1]

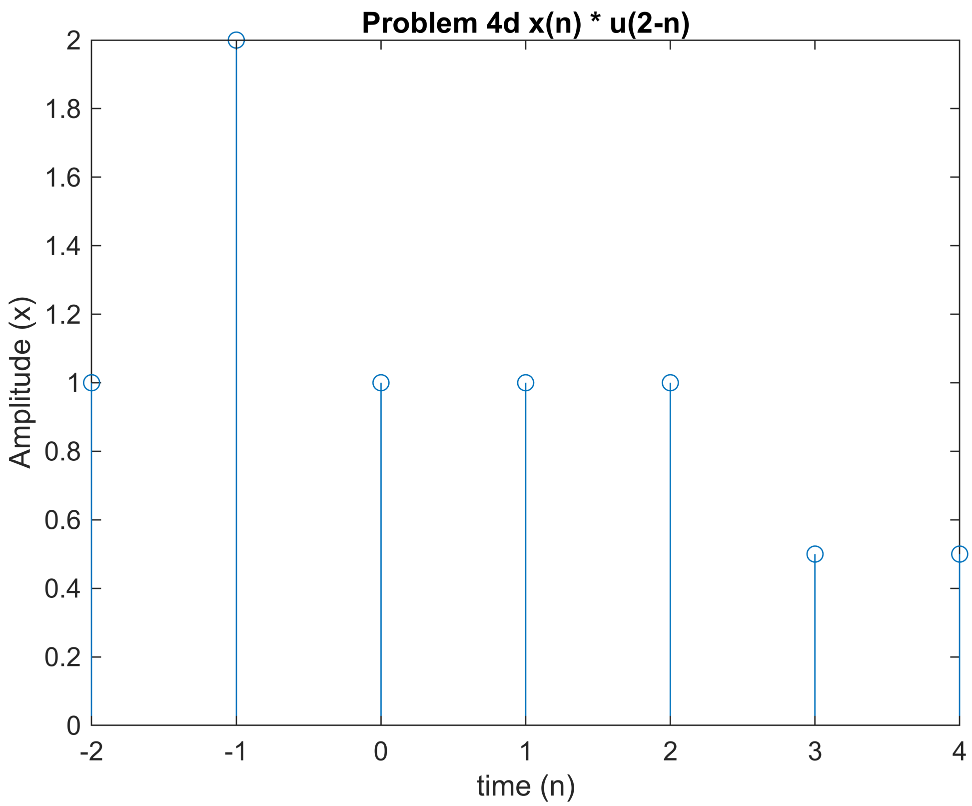
[x22da, n] = sigfold(x22d4, n);

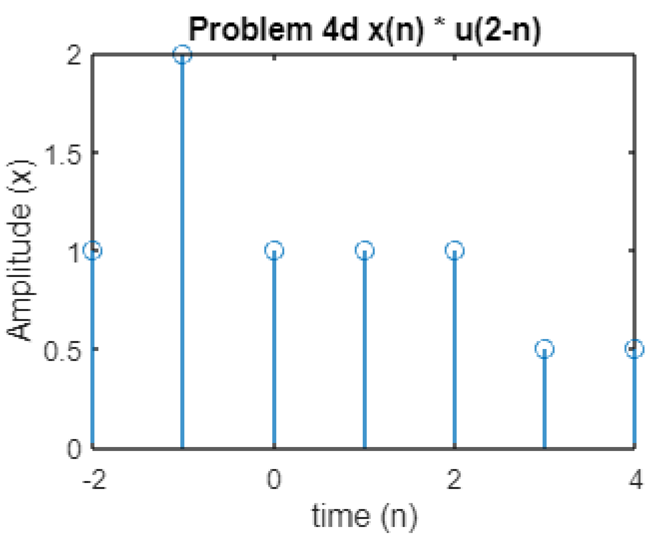
x22da = [1 1 1 0 0 0 0];

[x22d, n22] = sigadd(x22da, n22, x22, n22);

```
x22d = [ 1 2 1 1 1 0.5 0.5];
```

```
figure; stem(n22, x22d);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4d x(n) * u(2-n)");
```





Problem 4.e x(n-1) * delta(n-3)

[x22ea, n] = sigshift(x22, n , 1);

x22ea = [0 0 1 1 1 1 0.5]

[x22eb, n] = impseq(3, -4,2)

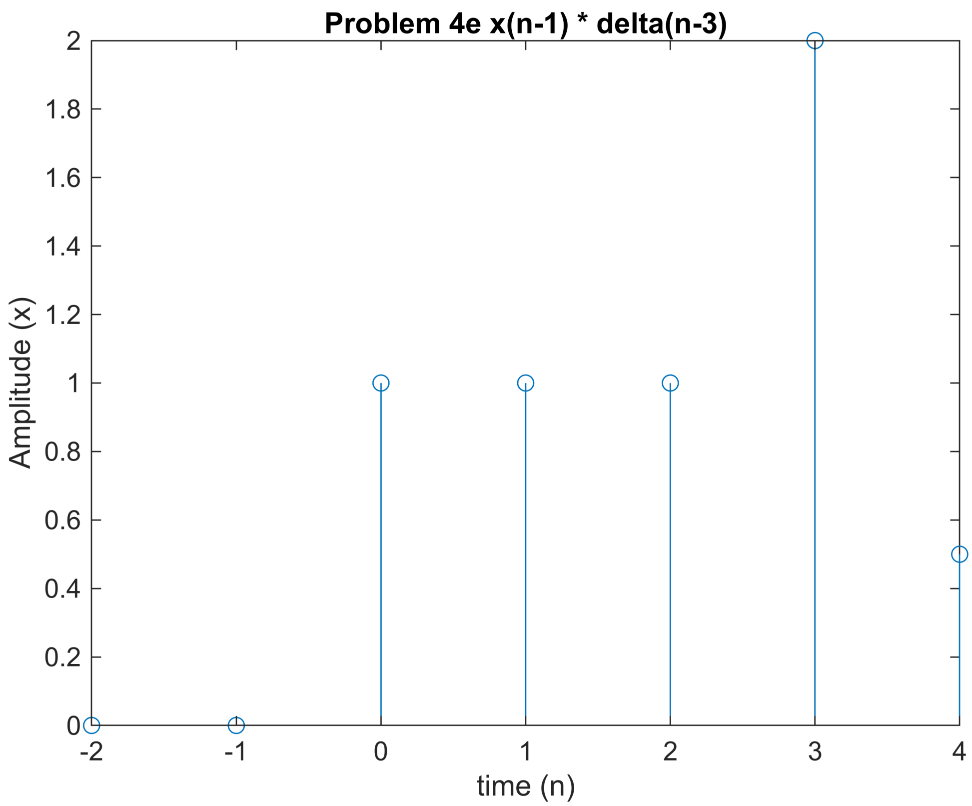
x22eb = [0 0 0 0 0 1 0]

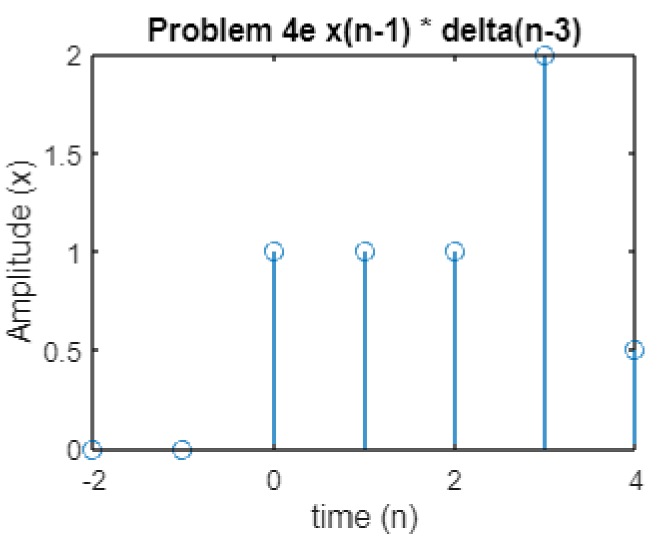
[x22e, n22] = sigadd(x22ea, n22, x22eb, n22)

```
x22e = [ 0 0 1 1 1 2 0.5]
```

```
x22e = 1×7
         0         0    1.0000    1.0000    1.0000    2.0000    0.5000
```

```
figure; stem(n22, x22e);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4e x(n-1) * delta(n-3)");
```





Problem 4.f x(n^2)

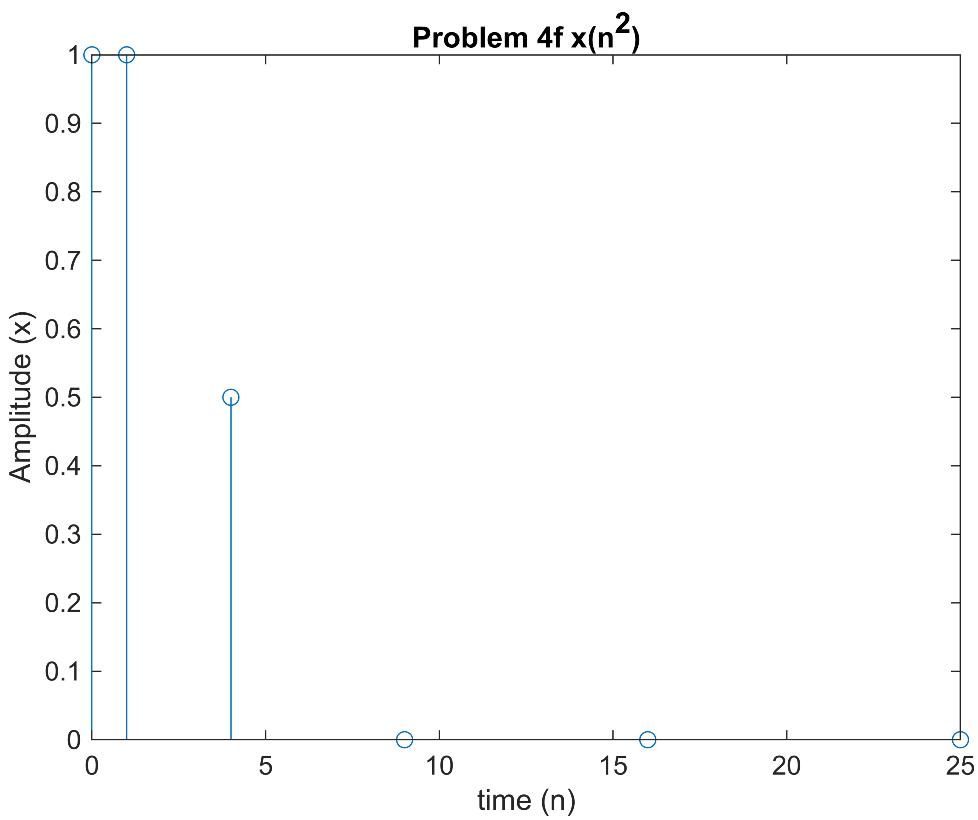
sqn = n .*n;

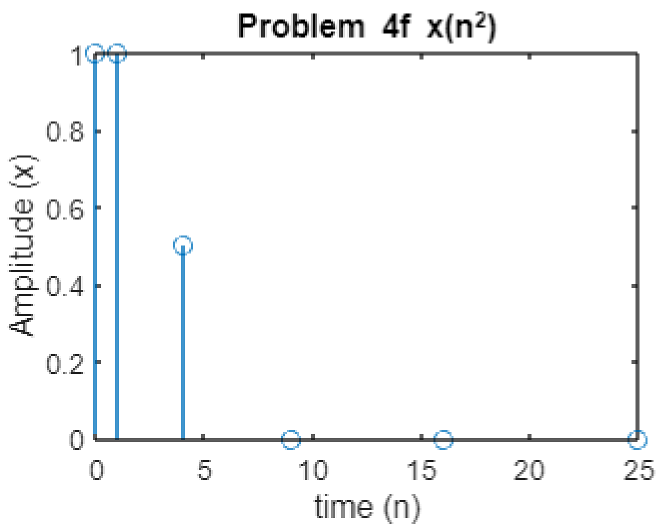
sqn = [0 1 4 9 16 25]

note that the range above is true although only ranges form zero to 25 due to the square.

Given that we only known values of x(n) from -2 to 4, we can insert this within the main values, and pass this we can also see that values are zero resulting in x(n^2):

```
x22f = [1 1 0.5 0 0 0];sqn = [  0     1     4     9    16    25];
figure; stem(sqn, x22f);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4f x(n^2)");
```



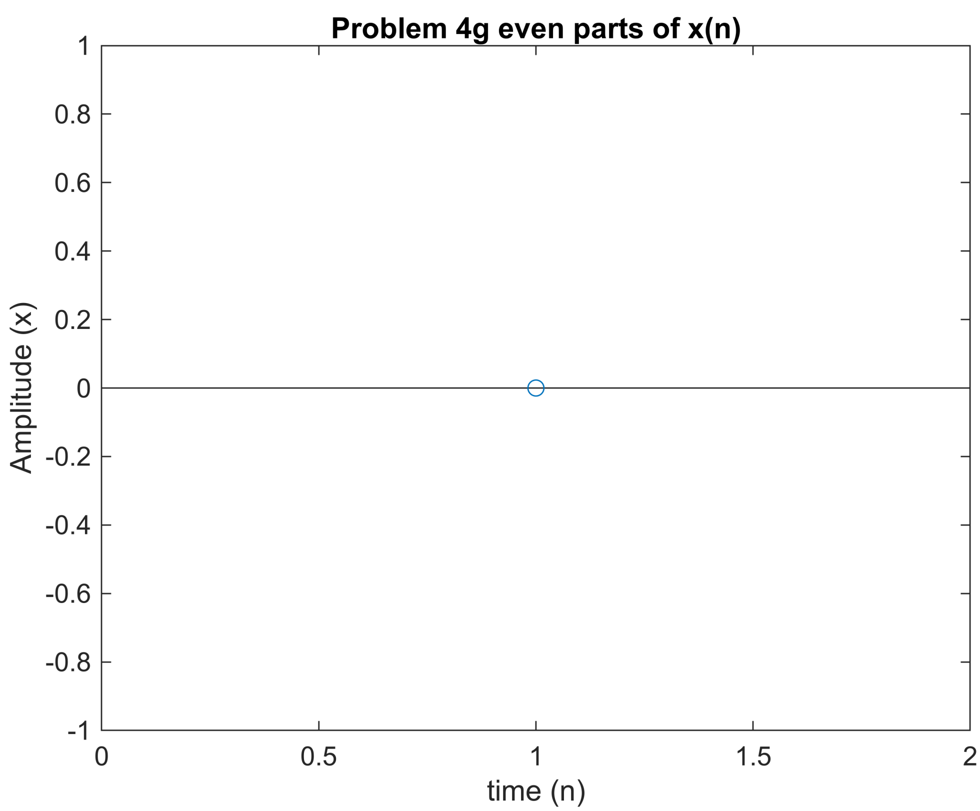


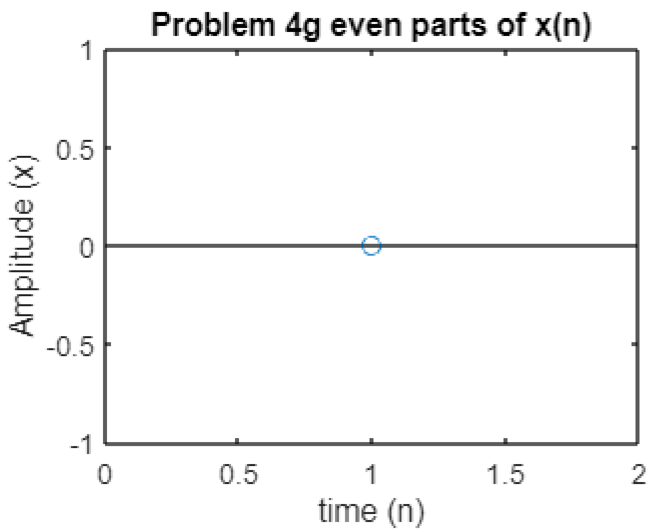
Problem 4.g even part of x(n)

note that iseven is to determine what values of the signal are even given that they are divisible by 2.

```
iseven = rem(x22, 2) == 0;
x22_even = x22(iseven);

figure; stem(x22_even);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4g even parts of x(n)");
```



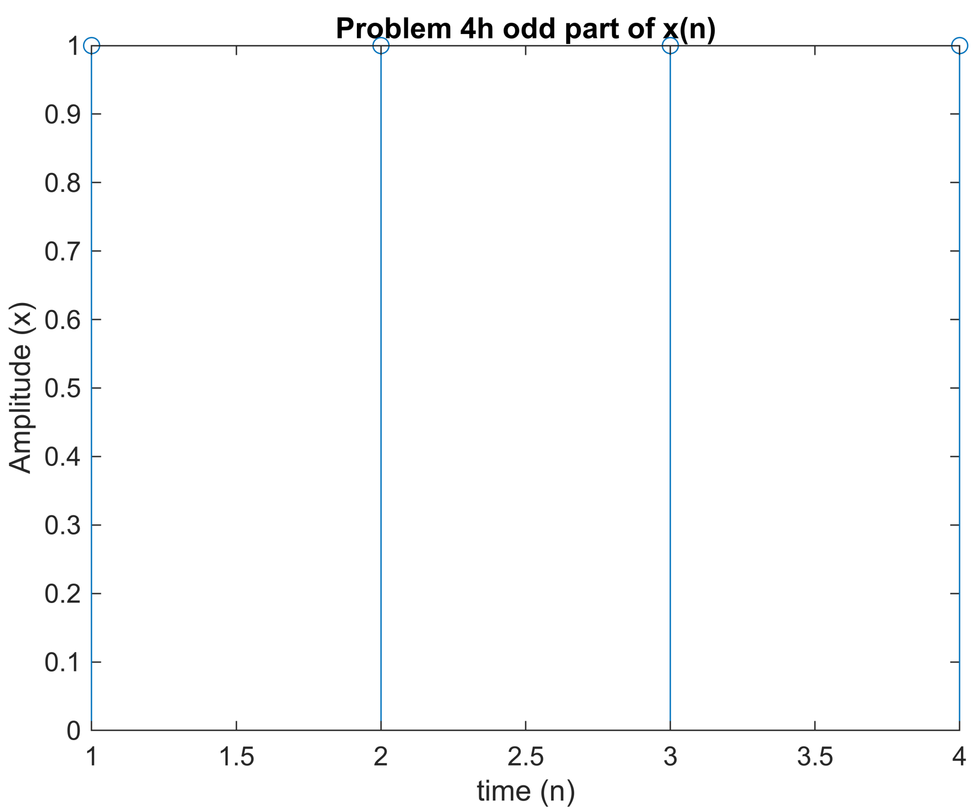


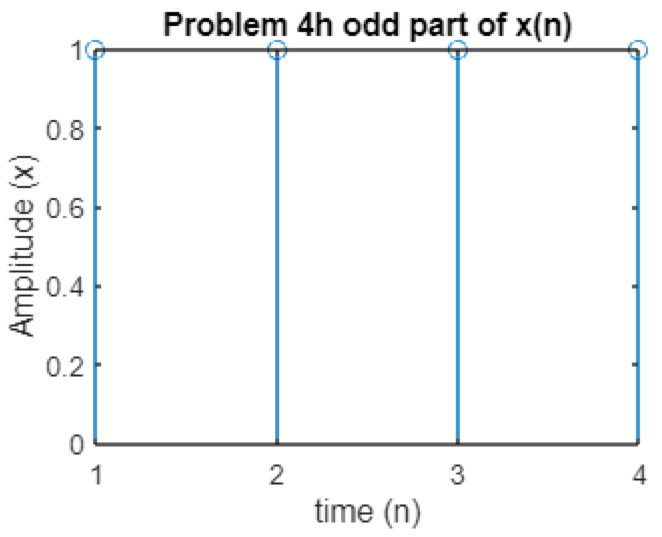
Problem 4.h odd part of x(n)

similar to part g, isodd is used to check if there is a remainer of a value when divided by 2.

```
isodd = rem(x22, 2) == 1;
x22_odd = x22(isodd);

figure; stem( x22_odd);
xlabel("time (n)"); ylabel("Amplitude (x)");
title("Problem 4h odd part of x(n)");
```





Problem 5: DSP: P&M 2.2

2.3 Show that

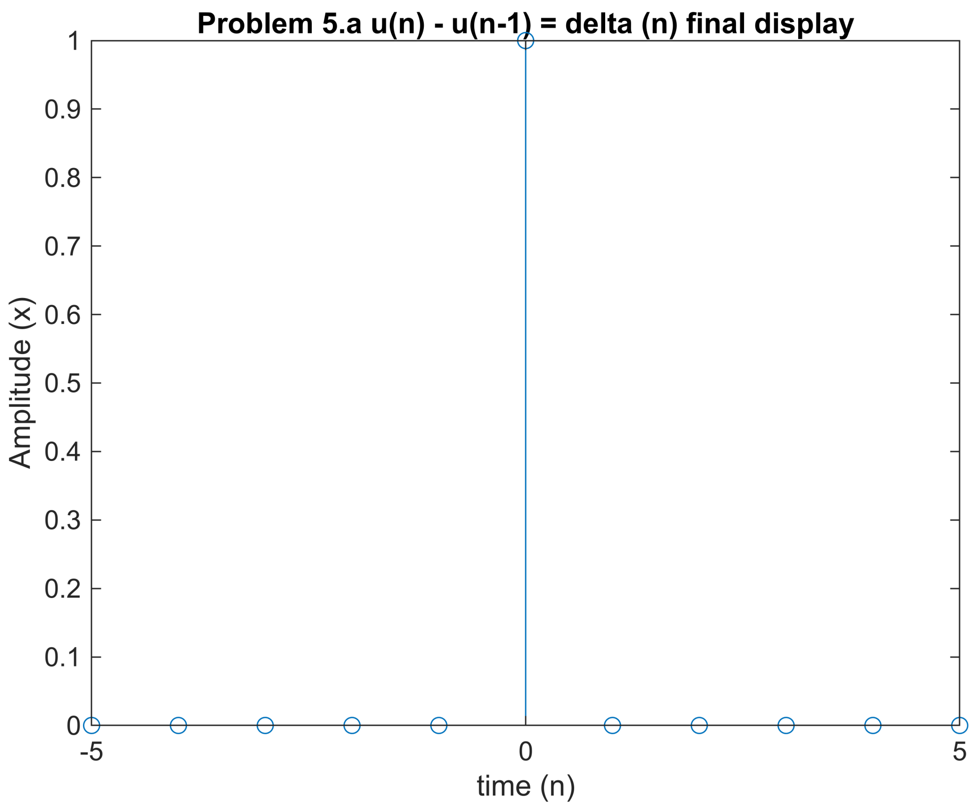
a. $\delta(n) = u(n) - u(n-1)$
b. $u(n) = \sum_{k=-\infty}^{n} \delta(k) = \sum_{k=0}^{\infty} \delta(n-k)$

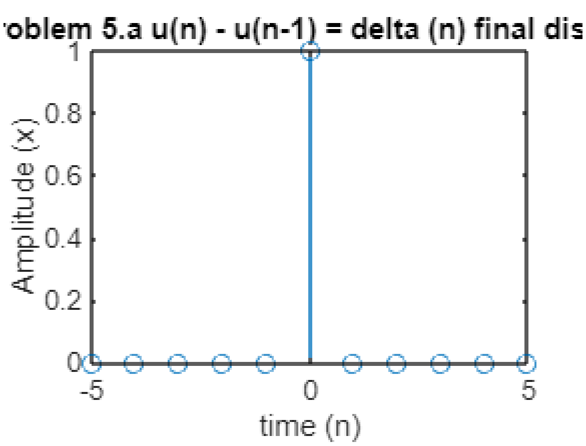
Problem 5.a delta(n) = u(n) - u(n-1)

First, to make this simpler to display and handle, an assumed range for n will be given, which in this case will be -5 to 5 as defined in Problem 1 already. With this done, I will then build a two part equation, with x5aa being the unit step, and x5ab being unit step with a shift of 1.

```
% n = [-5:5];
% x5aa = sigstep(0, -5, 5);
% x5ba = sigstep(1, -5, 5);
% %now that the two parts of the equation are built, now it's time to go
% %through and subtract these which I will do using sigadd with a negative
% %sign for x5ba.
% %please note that this was performed in the command window:
% [x5a, n] = sigadd(x5aa, n, -x5ab, n);
%the results are as follows:
%x5a = [0 0 0 0 0 1 0 0 0 0 0]; Which when graphed, displays the same as a
%delta or impulse function.
figure; stem(n, x5a);
```

```
title("Problem 5.a u(n) - u(n-1) = delta (n) final display");
xlabel("time (n)"); ylabel("Amplitude (x)");
```





Problem 5.b u(n) = delta(n -k) such that 0 <= k <= infinity

In order to prove that unit step is equal to delta(n - k) where k is a constant between zero and infinity, the delta function must first be established, and adjusted to meet the requirements of a constant k.

Within the command window I built delta(n - k), noting that n5a is a range between 0 and 10

```
n5a = [0, 10]; %values n1 and n2
%since in order to perform this function k needs a value, the value 2
```

```
[x5b, n] = impseq(k, 0,10)
```

with k = 2 the results are as follows:

x5b = [0   0   1   0   0   0   0   0   0   0   0]

This is the result of delta(n - k) which in this case is 2.

Required Function Code For HW1 execution:

energy.m

```
function [p] = energy( y,n)
%UNTITLED Summary of this function goes here
%   s is the input signal
%   t is the independent variable

y2 = y.^2;
%this gives us the power for each time instance n
p = sum(y2);
%Then, using MATLAB sum we can get the energy over the range
```

impseq.m

```
function[x, n] = impseq(n0, n1,n2)
%note that this is an impuse sequence
%generate x(n) = delta (n-n0), n1 <= n <= n2
% -------------------
% [x,n} = impseq(n0,n1,n2)
%
n = [n1:n2]; %impuse array
x = [(n - n0) == 0] %step array

%think of x here as an assert... it has to be one or zero
%because it is being done on an array element, it will be a row of 0s or 1s
%dependent on each individual value.

%note that in order to read this file through the help command,
%we need to be in the same search folder to obtain it
```

sigadd.m

```
function [y, n] = sigadd (x1, n1, x2, n2)
% y(n) = x1 (n) + x2(n)
% --------------------
% y is the sum of n, which incudes n1, n2
% x1 is the sequence over n1
```

```
% x2 is the sequence over n2
%

n = min(min(n1), min(n2)): max(max(n1), max(n2));
%this determines the min and max for all n
y1 = zeros(1, length(n));
y2 = y1;
y1(find((n >=min(n1))&(n <=max(n1))==1)) = x1;
y2(find((n >=min(n2))&(n <=max(n2))==1)) = x2;
%find here is allowing us to add x1 and x2 to a biger table that is y
y = y1 + y2;
```

sigfold.m

```
function [y, n] = sigfold (x, n)
% y(n) = x (-n)
% -------------------------
% This flips the index values of n
%

n = -fliplr(n);
y = fliplr(x);
```

sigmult.m

```
function [y, n] = sigmult(x1, n1, x2, n2)
% y(n) = x1(n) * x2(n)
% ---------------------
% y is the product of n including n1 and n2
% x1 is the sequence over n1
% x2 is the sequence over n2

%first finding the range of the each signal
n = [min(min(n1), min(n2)): max(max(n1), max(n2))];
%then finding the length of each signal itself
y1 = zeros(1, length(n)); y2 = y1;

%now we need to find and multiply each
y1(find(( n >= min(n1) & (n <= max(n2))) == 1)) = x1
y2(find(( n >= min(n1) & (n <= max(n2))) == 1)) = x2

%now to multiply these two together
y = y1 .* y2;
```

sigshift.m

```
function [y, n] = sigshift(x, m, k)
% y(n) = x(n + k)
% -------------------
% k is the shifting value
% single signal shift
```

```
if k > 0
    disp("positive")
    n = n(1):n(end)+k;
    y = [zeros(1,k) x];
else
    disp("negative")
    n = n(1)+k:n(end);
    y = [x zeros(1,abs(k))]; % abs is for absolute value of (k) because quantity can never be (
end
```

sigsub.m

```
function [y, n] = sigsub (x1, n1, x2, n2)
% y(n) = x1 (n) + x2(n)
% --------------------
% y is the sum of n, which incudes n1, n2
% x1 is the sequence over n1
% x2 is the sequence over n2
%

n = [min(min(n1), min(n2)): max(max(n1), max(n2))];
%this determines the min and max for all n
y1 = zeros(1, length(n)); y2 = y1;
y1(find( (n >= min(n1) & (n <= max(n2))) == 1)) = x1
y2(find( (n >= min(n1) & (n <= max(n2))) == 1)) = x2
%find here is allowing us to add x1 and x2 to a biger table that is y
y = y1 - y2
```

stepseq.m

```
function [x,n] = stepseq(n0,n1, n2)
%generates x(n) = u(n-n0), n1 <= n <= n2
%-----------------------
% [x,n] = stepseq(n0,n1,n2)
%
n = [n1:n2]; % step array
x = [(n - n0) >= 0]; %index array

%remember that for a step signal, everything is zero between n1 and n2
%everything on the left of n0 is zero, everything on the right of n0 is one

%note that semicolon means it will not print to the UI
```