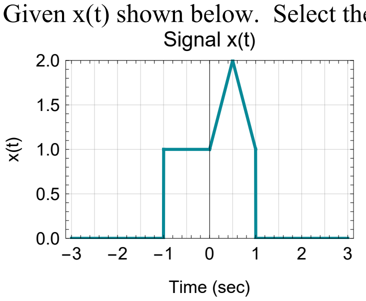
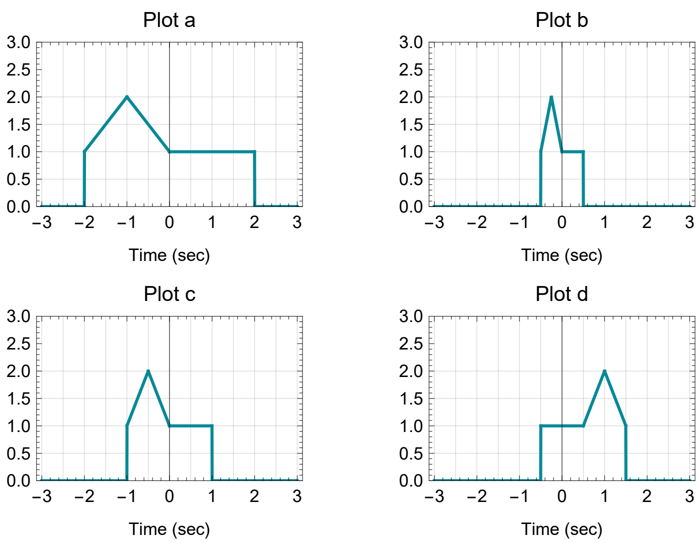
EECS 361
Concept Question #1

1. Given x(t) shown below. Select the correct plot x(-t).





2. How can you see solutions to homework problems?

a. Ask for a problem to be worked in class

b. Come to office hours and ask to see a problem worked.

c. Schedule a time to come to my office and ask to see a problem worked.

d. All the above

3. How are late homework submissions managed?

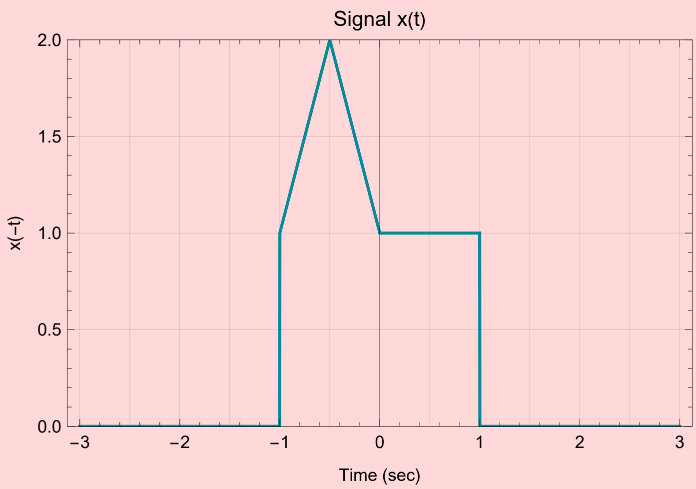
a. A 0 is assigned to all late submission.

b. If you contact me (and cc the grader) via email before due date/time as soon as possible to arrange an suitable due date the assignment will be graded.

c. If you contact me (and cc the grader) via email after due date/time to arrange an alternative due date the assignment will be graded.

In[1]:=
```
x[t_] = UnitBox[t/2] + UnitTriangle[(t - .5)/.5];
Plot[x[-t], {t, -3, 3}, PlotRange → {0, 2},
 GridLines → {Range[-3, 3, 0.5], Range[0, 2, 0.5]}, Frame → True,
 FrameLabel → {"Time (sec)", "x(-t)"}, ExclusionsStyle → Automatic, PlotLabel → "Signal x(t)"]
```

Out[2]=



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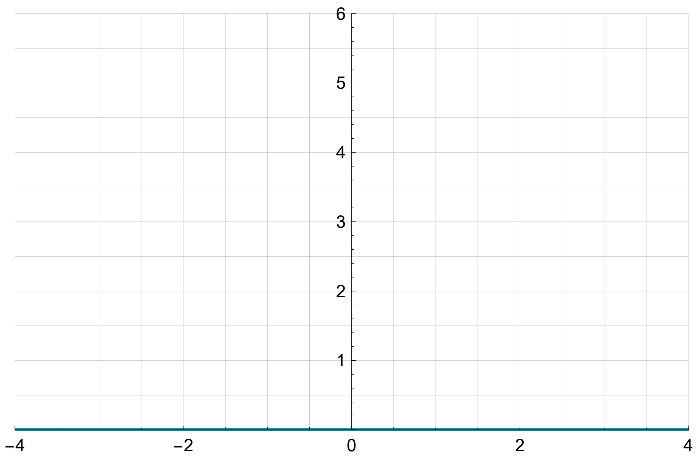
Concept Question #2

1. Let x(t) = 5tri(t). What is $\int_{-\infty}^{\infty} \delta(\tau)\, x(\tau)\, d\tau$?

2. What is $\int_{-\infty}^{\infty} \delta(\tau - 3)\, x(\tau)\, d\tau$?

3. What is $\int_{-\infty}^{\infty} \delta(\tau - 0.5)\, x(\tau)\, d\tau$?

Hint: sketch x(t) on



1.

In[∘]:=
```
x[t_] = 5 * UnitTriangle[t];
∫_{-∞}^{∞} DiracDelta[τ] * x[τ] dτ
```

Out[∘]=
```
5
```

2.

In[∘]:=
```
∫_{-∞}^{∞} DiracDelta[τ - 3] * x[τ] dτ
```

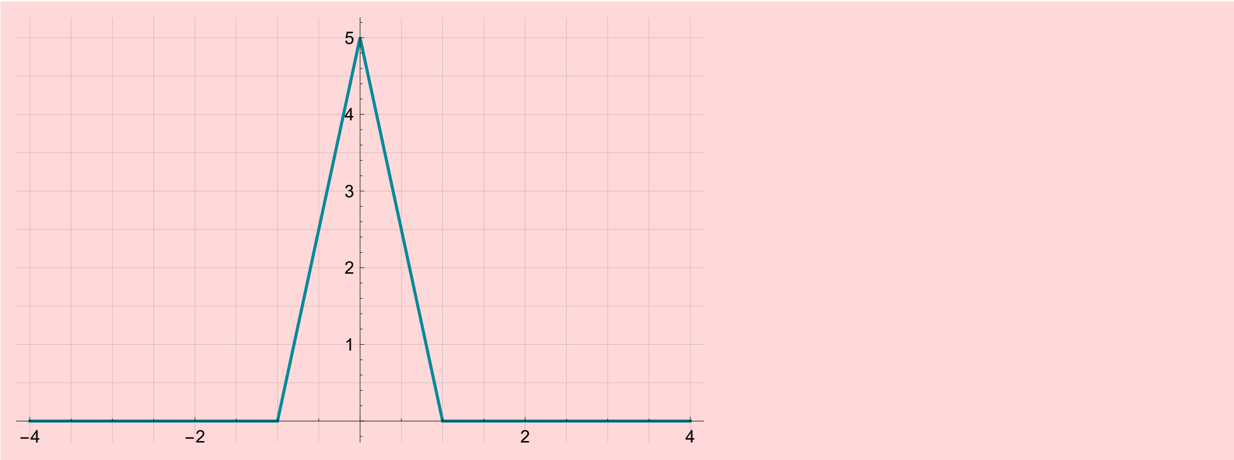
Out[∘]=
```
0
```

3.

In[∘]:=
```
∫_{-∞}^{∞} DiracDelta[τ - .5] * x[τ] dτ
```

Out[∘]=
```
2.5
```

Out[ ]=



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Concept Question #3

1. Let x(t) = $\sqrt{2}\cos(\omega_1 t) + 2\cos(\omega_2 t)$ where $\omega_1 \neq \omega_2$. What is the average power in x(t)?

2. Let y(t) = $\sqrt{2}\cos(\omega_1 t + 0.7)$. What is the average power in y(t)?

1.

In[ ]:=

$$\frac{(\sqrt{2})^2}{2} + \frac{(2)^2}{2}$$

Out[ ]=

3

2.

$$\frac{(\sqrt{2})^2}{2}$$

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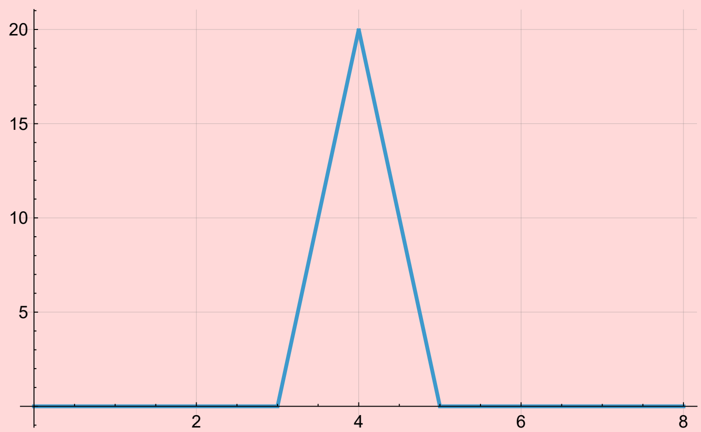
Concept Question #4

1. Let the system input be x(t) = $5\delta(t-4)$ and the system impulse response of an LTI system be h(t) = $4\text{tri}(\frac{t}{2})$. Find the system output y(t) = x(t)$*$h(t).

In[ ]:=
```
y[t_] = Convolve[5 * DiracDelta[τ - 4], 4 * UnitTriangle[τ], τ, t]
```

Out[ ]=
```
20 UnitTriangle[4 - t]
```

Out[ ]=



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Concept Question #5

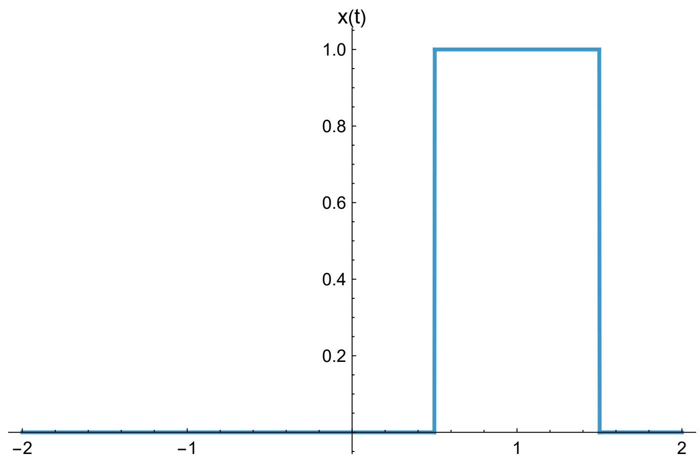
1. Let the system input be x(t) = rect(t-1) and the system impulse response of an LTI system be h(t) = t^2 rect(t – 0.5). Find the system output y(t) = x(t)∗h(t).

a. y(0)

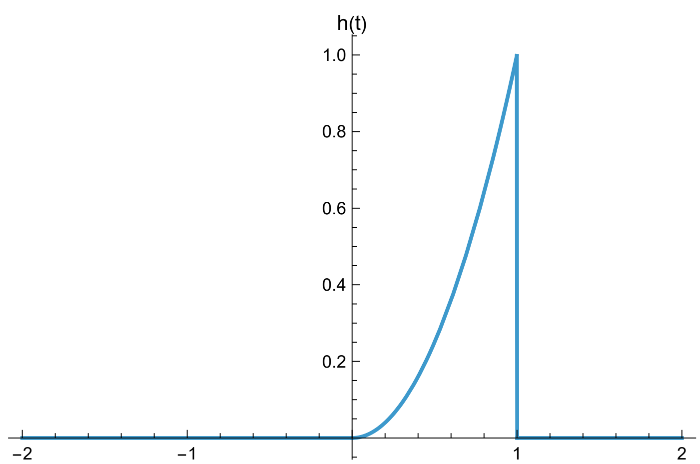
b. set up equation to find y(1.5)

c. Find y(1.5)

Out[9]=



Out[7]=



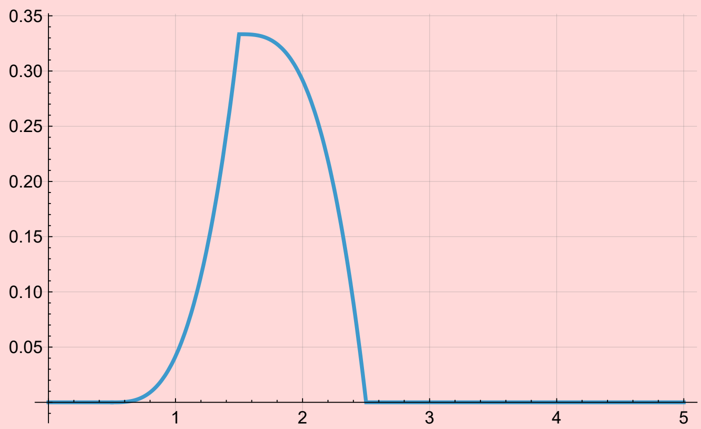
In[◦]:=
```
y[t_] = Convolve[UnitBox[τ - 1], τ^2 * UnitBox[τ - 0.5], τ, t]
```

Out[◦]=

$$\begin{cases} 1.45833 - 2.25\,t + 1.5\,t^2 - 0.333333\,t^3 & 1.5 < t < 2.5 \\ 0.333333\,(-0.5 + 1.\,t)^3 & 0.5 < t \le 1.5 \\ 0. & \text{True} \end{cases}$$

In[◦]:=
```
Plot[y[t], {t, 0., 5.}, PlotRange → All, GridLines → Automatic]
```

Out[◦]=



In[◦]:=
```
y[1.5]
```

Out[◦]=
```
0.333333
```

In[◦]:=

$$\int_0^{1.} t^2\, dt$$

Out[◦]=
```
0.333333
```

$$y1[t\_] = \int_0^{t-.5} \lambda^2\, d\lambda \quad (*\text{from } 0.5 \text{ to } 1.5*)$$

Out[◦]=

$$\frac{1}{3}(t - 0.5)^3$$

```
y2[t_] = ∫_{t-1.5}^{1} λ^2 dλ (*from 1.5 to 2.5*)
```

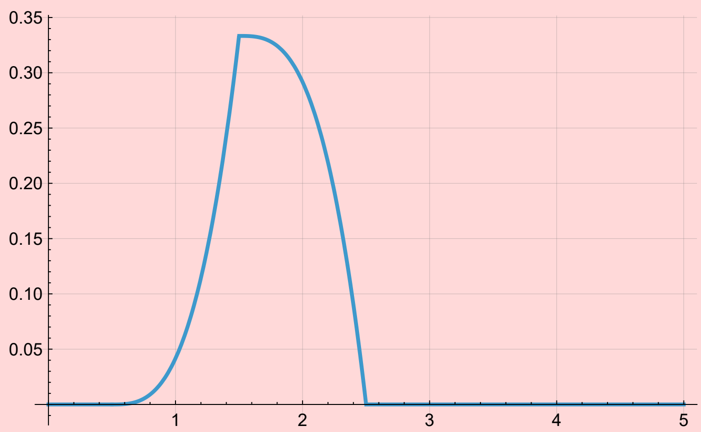
Out[ ]=

$$\frac{1}{3} - \frac{1}{3}(t - 1.5)^3$$

In[ ]:=

```
Plot[y1[t] * UnitBox[t - 1] + y2[t] * UnitBox[t - 2], {t, 0, 5}, GridLines → Automatic]
```

Out[ ]=



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Concept Question #6

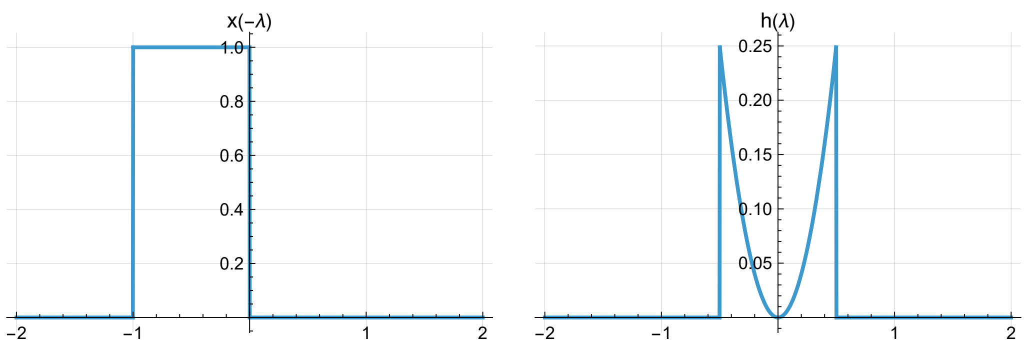
1. Let the system impulse response of an LTI system be h(t) = t^2 rect(t).

a. Is the system causal.

b. Is the system stable.

c. The system input be x(t) = rect(t-$\frac{1}{2}$) and find the system output y(t) = x(t)∗h(t).

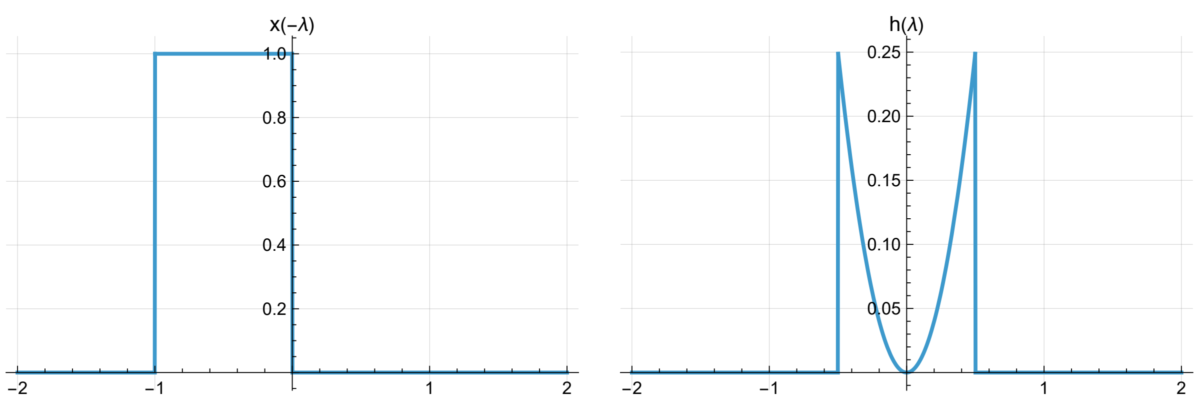
Hint:



a. Non-causal

b. Stable

Out[∘]=



Case 1 -0.5<t<0.5

In[ ]:=
```
y1[t_] = UnitBox[t] * ∫_{-.5}^{t} t^2 ⅆt
```

Out[ ]=

$$\left(\frac{t^3}{3} + 0.0416667\right) \Pi(t)$$

Case 2 0.5<t<1.5

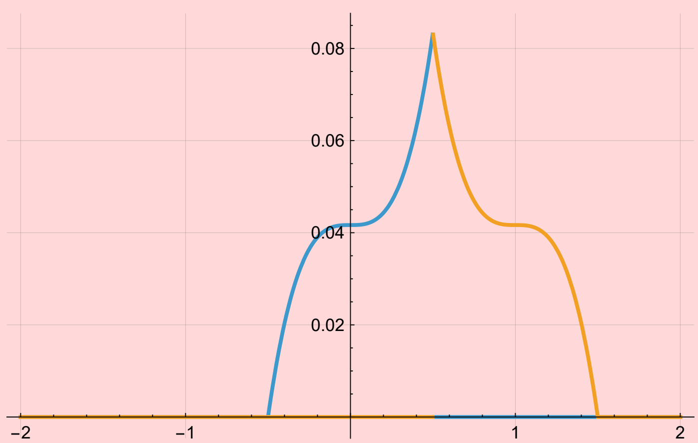
In[ ]:=
```
y2[t_] = UnitBox[t - 1] * ∫_{t-1}^{.5} t^2 ⅆt
```

Out[ ]=

$$\left(0.0416667 - \frac{1}{3} (t - 1)^3\right) \Pi(1 - t)$$

In[ ]:=
```
Plot[{y1[t], y2[t]}, {t, -2., 2.}, PlotRange → All, GridLines → Automatic]
```

Out[ ]=



Check result

In[ ]:=
```
y[t_] = Convolve[x[τ], h[τ], τ, t];
```

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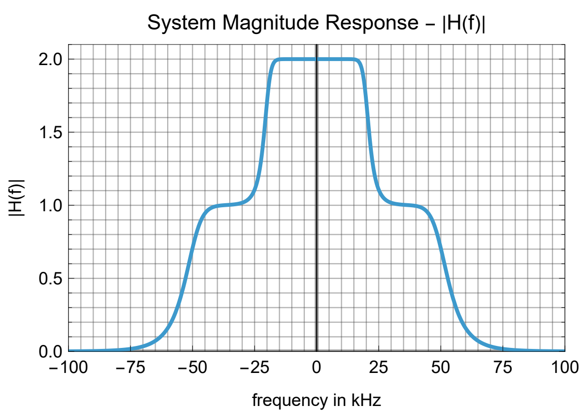
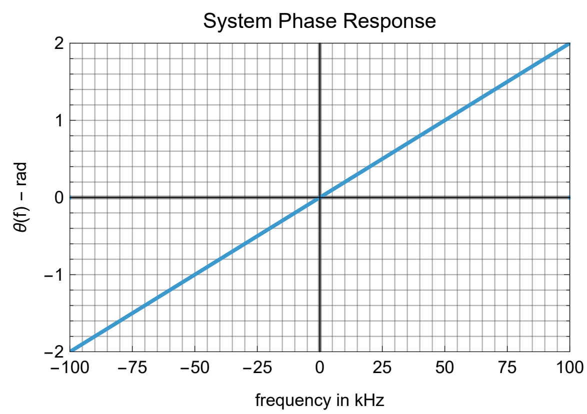
Concept Question #7

1. An LTI system has the magnitude and phase response shown below.





a For an input signal $x(t) = \cos(2\pi 15000t)$ find the output signal.

b. For an input signal $x(t) = \cos(2\pi 15000t) + \cos(2\pi 30000t)$ find the output signal.

c. For an input signal $x(t) = \cos(2\pi 15000t) + \cos(2\pi 30000t) + \cos(2\pi 100000t)$ find the output signal.

a . $2\cos(2\pi 15000t + 0.3)$

In[ ]:=
```
w1 = 15.;
H3[w1, 20] + H3[w1, 50]
-A3[w1]
```

Out[ ]=
```
1.99842
```

Out[ ]=
```
0.3
```

b.

In[ ]:=
```
w2 = 30.;
H3[w2, 20] + H3[w2, 50]
-A3[w2]
```

Out[ ]=
```
1.01732
```

Out[ ]=
```
0.6
```

$2\cos(2\pi 15000t - .3) + \cos(2\pi 15000t + 0.6)$

c. $2\cos(2\pi 15000t - .3) + \cos(2\pi 15000t + 0.6)$

1. A system is defined by $\frac{dy(t)}{dt}$+y(t) = x(t).

a For an input signal x(t) = 1 find the output signal.

b. For an input signal x(t) = cos(t) find the output signal.

a. 1

In[∘]:=
```
H[w_] = 1/(1 + I*w);
```

b. $\sqrt{2}\cos\left(t-\frac{\pi}{4}\right)$

In[∘]:=
```
H[1]
```

Out[∘]=

$\frac{1}{2}-\frac{i}{2}$

In[∘]:=
convert to exponential $\frac{1}{2}-\frac{i}{2}$

Out[∘]=

$\frac{e^{\frac{1}{4} i (-\pi)}}{\sqrt{2}}$

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Concept Question #9

1. A system has an input of x(t)=cos(2π100t); for this system the output is y(t)=0.5cos(2π100t)+0.2cos(2π200t). The system is LTI. **FALSE.**

2. For $x_p(t) = \sum_{k=-\infty}^{\infty} \mathrm{rect}\left(\frac{t-kT_o}{\tau}\right)$ as T_o increases the spacing between the spectral lines in the magnitude spectrum of $x_p(t)$ will

i. Increase

<u>ii. Decrease</u>

iii Stay the same

Answer: ___

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Concept Question #10

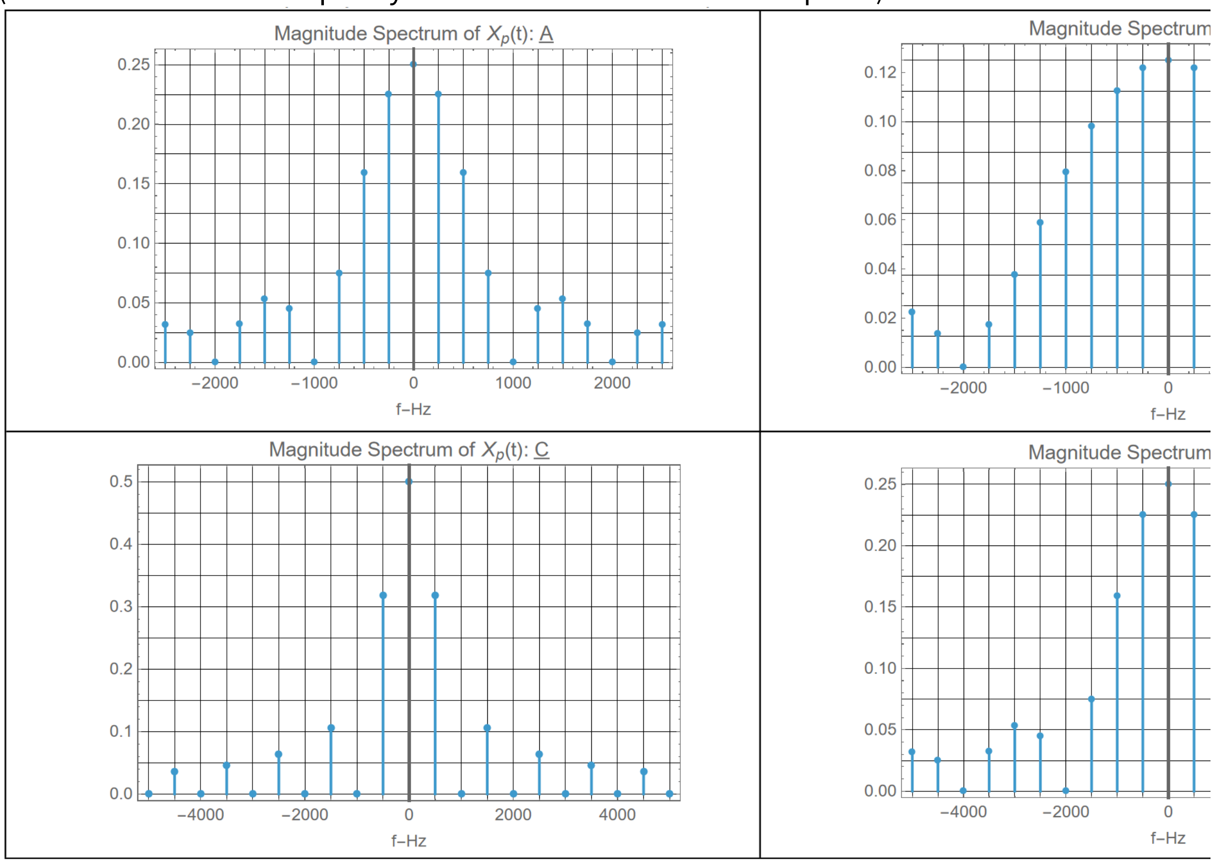
1. Given a periodic signal $x_p(t)$.

$$x_p(t) = \sum_{k=-\infty}^{\infty} rect\left(\frac{t-kT_0}{\tau}\right)$$

The plot of the Magnitude Spectrum of x_p (t) is shown below for different combinations of the pulse width = τ, and period = T_0.

Fill in the table below, that is, match the sets of signal parameters (1, 2, 3, 4)) to a Magnitude Spectrum plot (A, B, C, D).

(Note the scale of the frequency axis is not the same for all four plots.)



Signal Paramters (units seconds)	Magnitude Spectrum of X_p (t)
1 : $\tau = 0.5*10^{-3}$ $T_0 = 4*10^{-3}$	B
2 : $\tau = 1.0*10^{-3}$ $T_0 = 2*10^{-3}$	C
3 : $\tau = 0.5*10^{-3}$ $T_0 = 2*10^{-3}$	D
4 : $\tau = 1.0*10^{-3}$ $T_0 = 4*10^{-3}$	A