6.003 (Spring 2010)

Quiz #3 *April 28, 2010*

Name:

Kerberos Username:

Please circle your section number:

Section	*Instructor*	*Time*
1	Peter Hagelstein	10 am
2	Peter Hagelstein	11 am
3	Rahul Sarpeshkar	1 pm
4	Rahul Sarpeshkar	2 pm

Grades will be determined by the correctness of your answers (explanations are not required).

Partial credit will be given for ANSWERS that demonstrate some but not all of the important conceptual issues.

You have **two hours.**

Please put your initials on all subsequent sheets.

Enter your answers in the boxes.

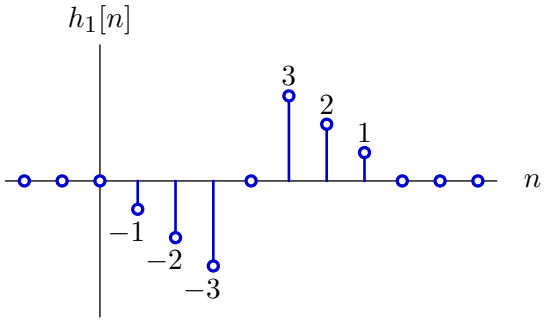
This quiz is closed book, but you may use three 8.5×11 sheets of paper (six sides total).

No calculators, computers, cell phones, music players, or other aids.

1	/24
2	/20
3	/36
4	/20
Total	/100

1. Unit-sample responses *[24 points]*

Part a. Find the frequency response of a linear, time-invariant system whose unit-sample response $h_1[n]$ is shown below ($h_1[n]$ is zero outside the indicated range).

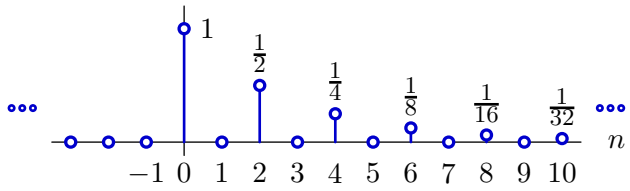


Enter a closed-form expression for the frequency response in the box below.

frequency response =

Part b. Find the frequency response of a linear, time-invariant system whose unit-sample response $h_2[n]$ is shown below.

$$h_2[n] = \begin{cases} \left(\frac{1}{2}\right)^{n/2} & n = 0, 2, 4, 6, 8, \ldots, \infty \\ 0 & \text{otherwise} \end{cases}$$

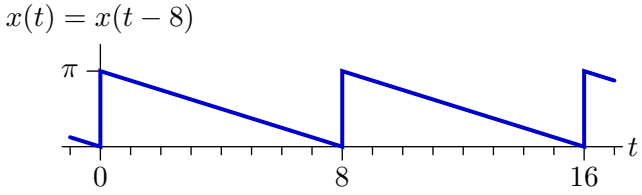


Enter a closed-form expression for the frequency response in the box below.

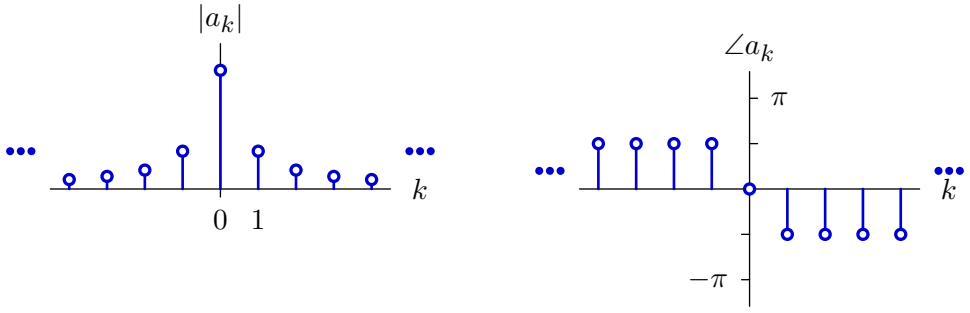
frequency response=

2. Matching *[20 points]*

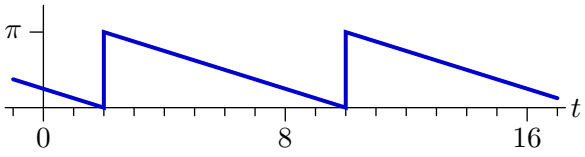
The following periodic signal $x(t)$ has period $T = 8$.



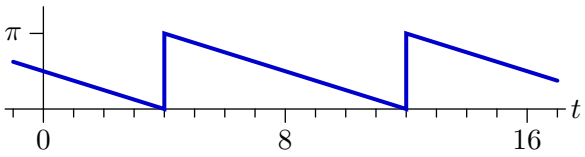
The magnitude and phase of the Fourier series coefficients a_k of $x(t)$ are given below.



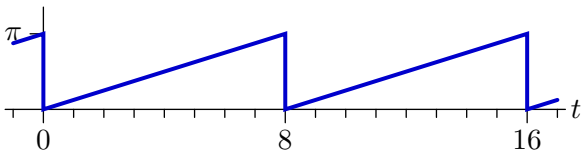
Determine which angle function from the next page corresponds to each of these signals:



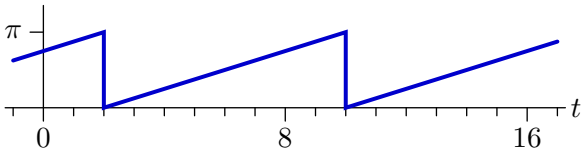
A, **B**, ... **F** or **none**: ☐



A, **B**, ... **F** or **none**: ☐

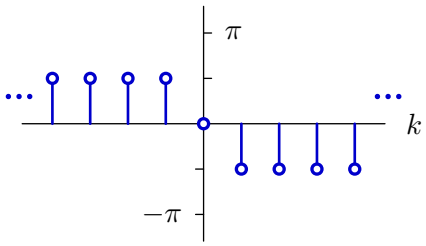


A, **B**, ... **F** or **none**: ☐

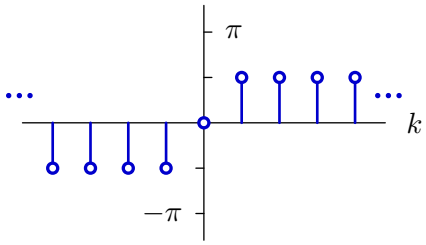


A, **B**, ... **F** or **none**: ☐

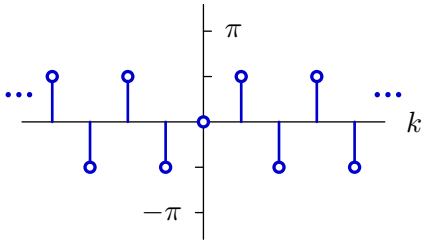
A



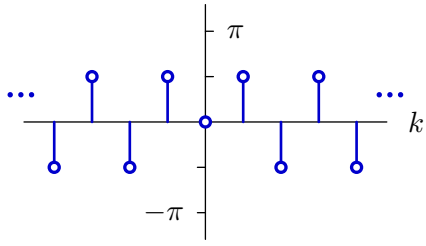
B



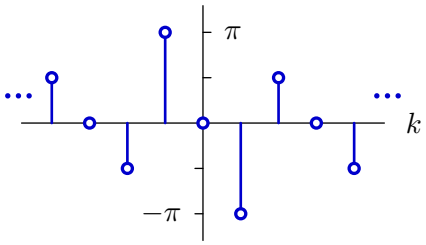
C



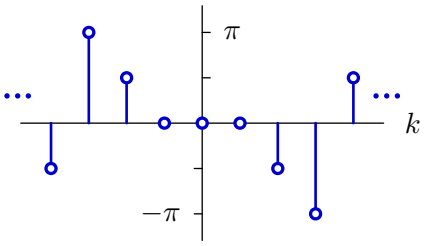
D



E

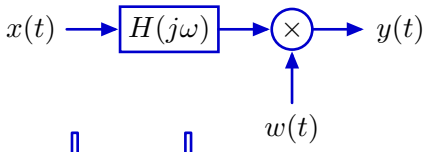


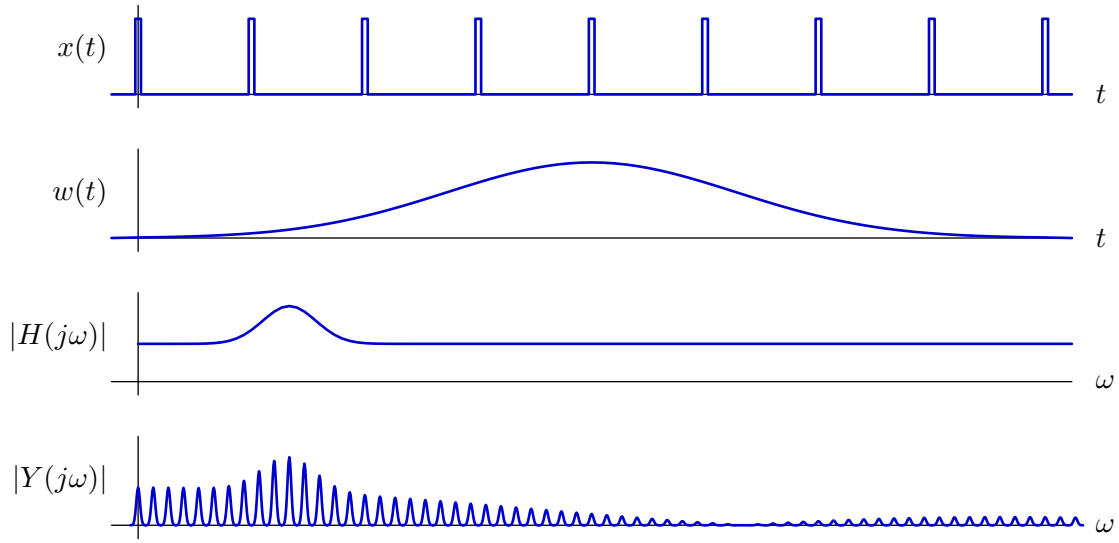
F



3. Scaling *[36 points]*

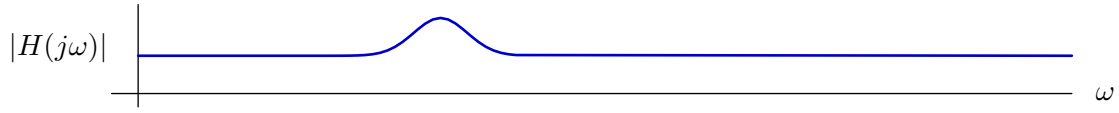
Let $x(t)$ represent an infinite sequence of pulses, which is passed through an LTI filter $H(j\omega)$ and then multiplied by $w(t)$ to produce $y(t)$, as shown on the right.



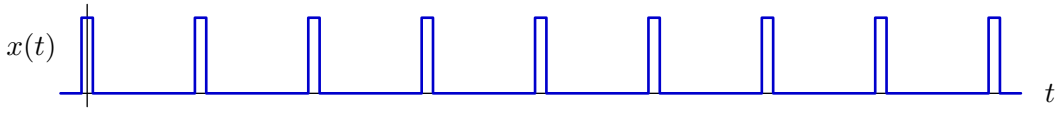


Only one of the previous signals is changed in each of the following parts. Identify the corresponding result from the list on the next page (original $|Y(j\omega)|$ shown for reference).

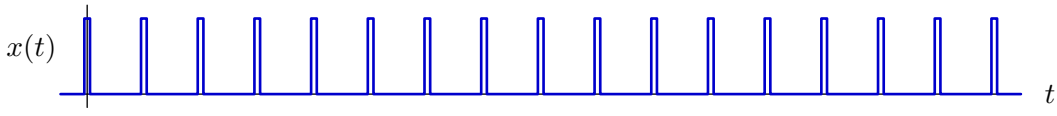
Part a. The peak of $H(j\omega)$ is shifted to a higher frequency. **1, 2, ... 10,** or **none**: ☐



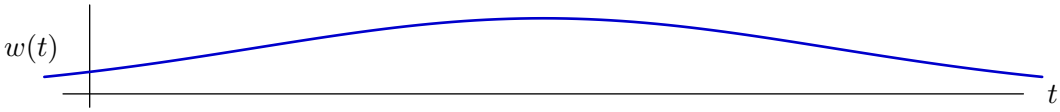
Part b. The duration of each pulse in $x(t)$ is doubled. **1, 2, ... 10,** or **none**: ☐

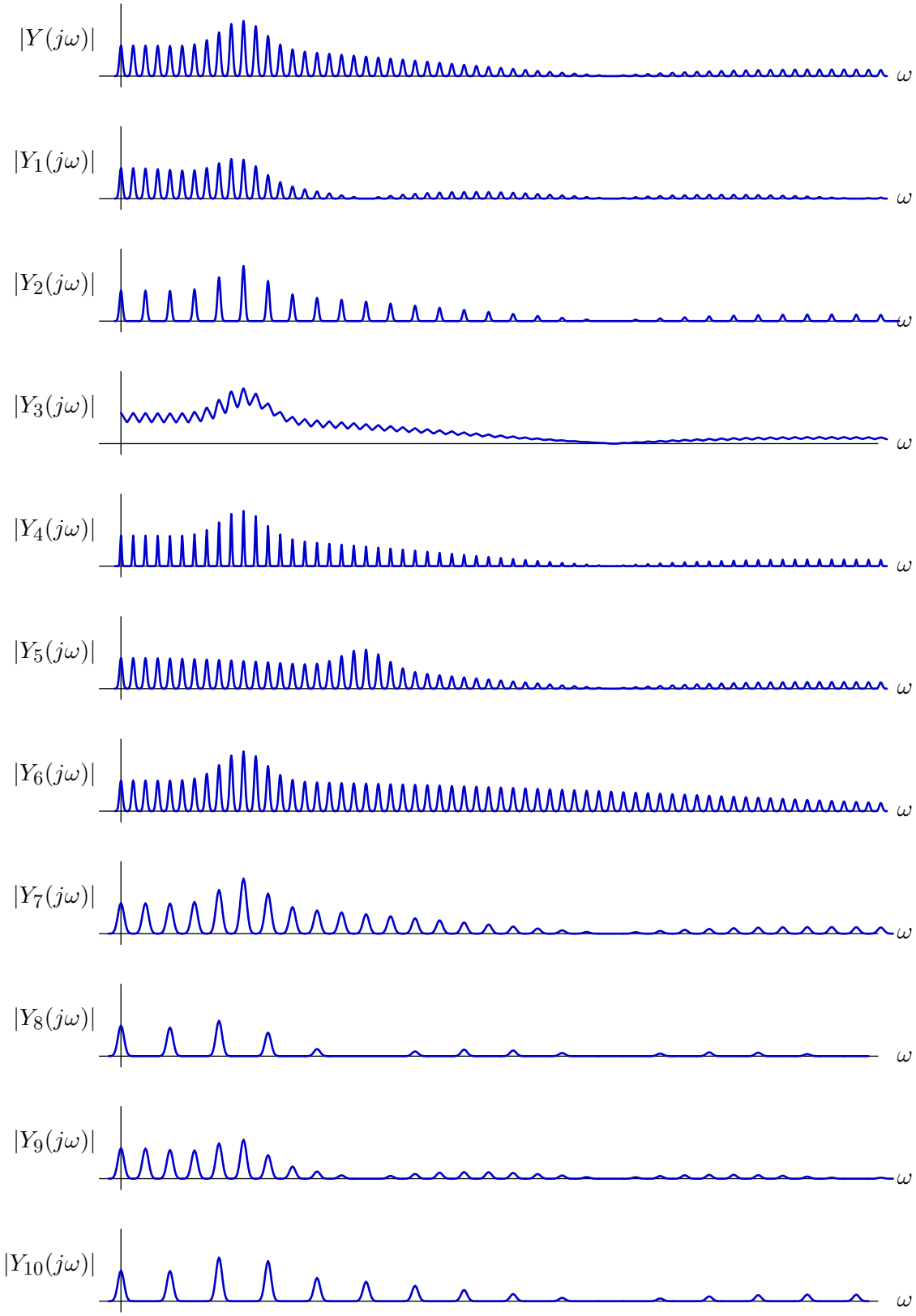


Part c. The period of $x(t)$ is halved. **1, 2, ... 10,** or **none**: ☐



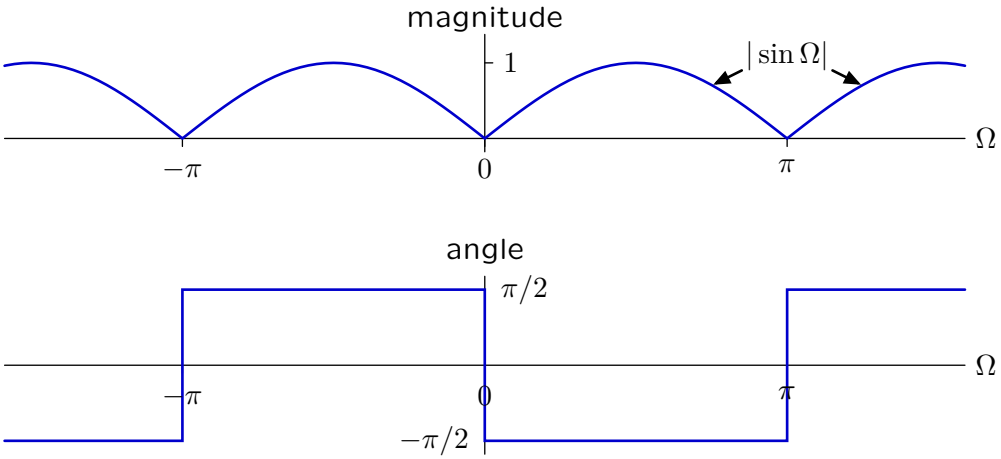
Part d. The duration of $w(t)$ is doubled. **1, 2, ... 10,** or **none**: ☐



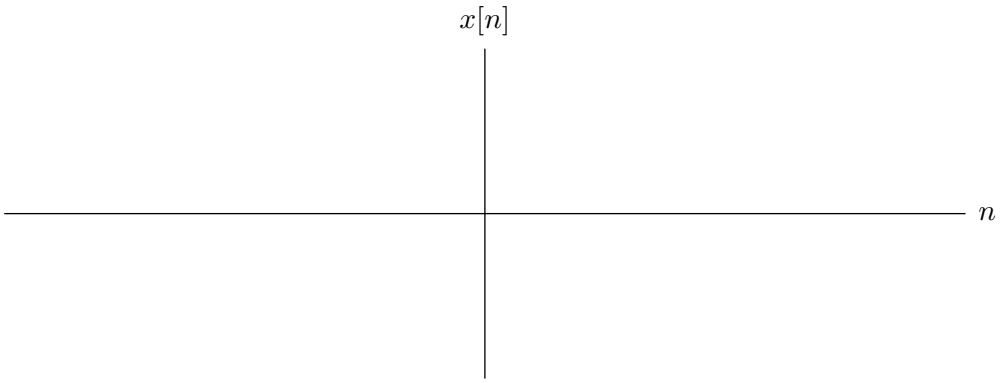

$|Y(j\omega)|$
ω
$|Y_1(j\omega)|$
ω
$|Y_2(j\omega)|$
ω
$|Y_3(j\omega)|$
ω
$|Y_4(j\omega)|$
ω
$|Y_5(j\omega)|$
ω
$|Y_6(j\omega)|$
ω
$|Y_7(j\omega)|$
ω
$|Y_8(j\omega)|$
ω
$|Y_9(j\omega)|$
ω
$|Y_{10}(j\omega)|$
ω

4. Inverse Fourier *[20 points]*

The magnitude and angle of the Fourier transform of $x[n]$ are shown below.



Sketch and fully label $x[n]$ on the axes below.



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Spring 2010

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