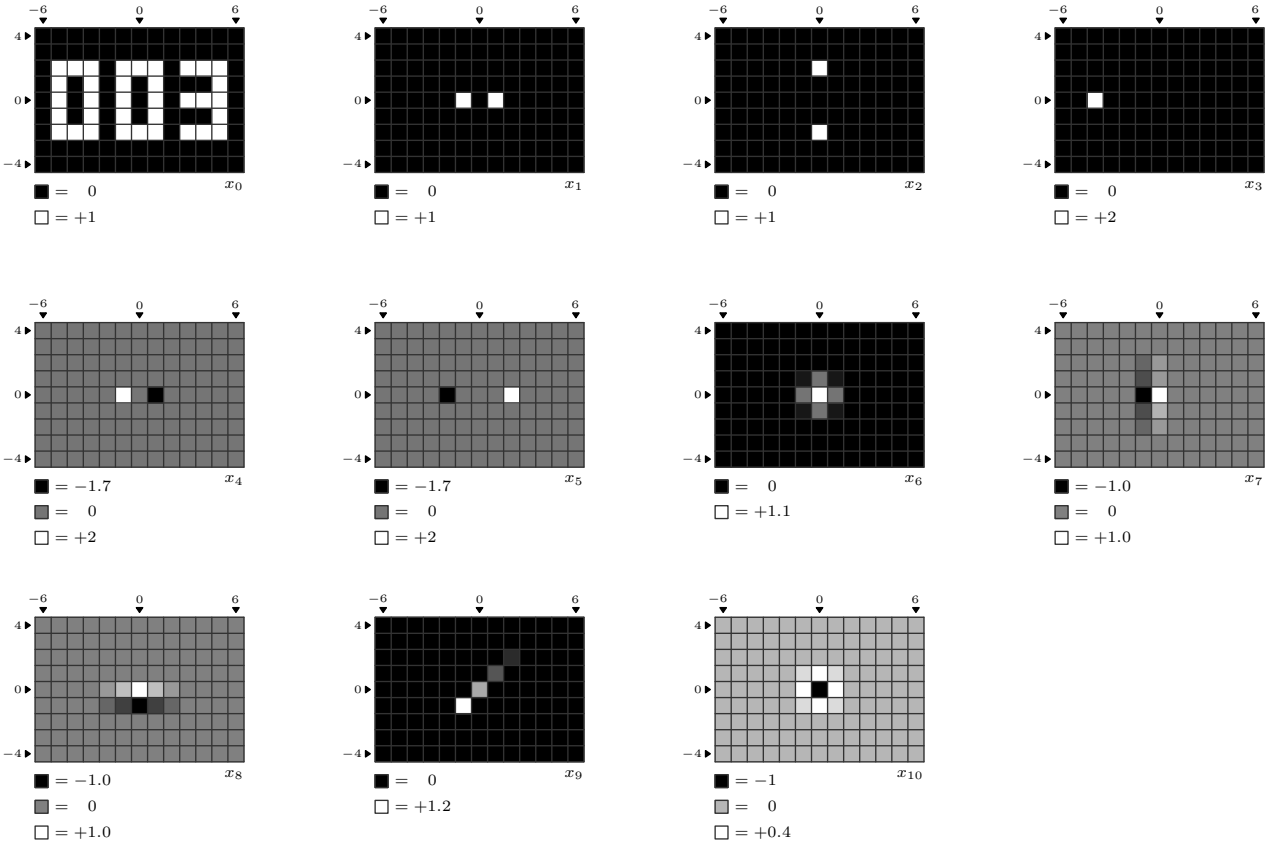
6.3000 Review Questions

2D Convolution (16 Points)

For this problem, we will consider the following 2D signals, labeled x_0 through x_{10}, each of which is 9 rows $\times$ 13 columns. Note that the color scale is different between some of the signals.

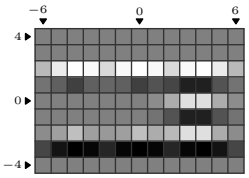


For each circular convolution below, indicate which of the graphs on the facing page most closely matches the result by entering a single letter in each box. Note that, for each graph on the facing page, black corresponds to the lowest value in the signal (not necessarily 0), and white corresponds to the highest value in the signal (not necessarily 1).

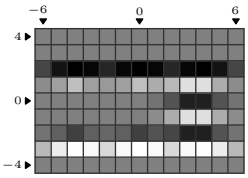
$x_1 \circledast x_0$ ☐ $x_2 \circledast x_0$ ☐ $x_3 \circledast x_0$ ☐

$x_4 \circledast x_0$ ☐ $x_5 \circledast x_0$ ☐ $x_6 \circledast x_0$ ☐ $x_7 \circledast x_0$ ☐

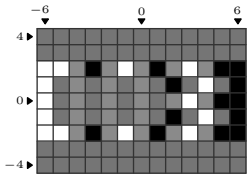
$x_8 \circledast x_0$ ☐ $x_9 \circledast x_0$ ☐ $x_{10} \circledast x_0$ ☐



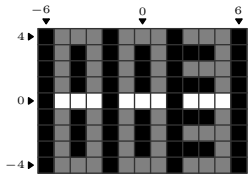
Graph A



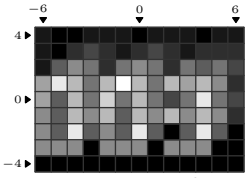
Graph B



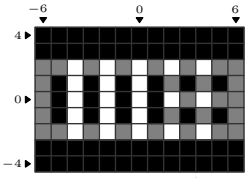
Graph C



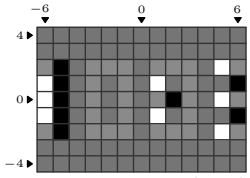
Graph D



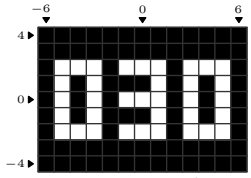
Graph E



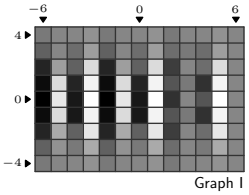
Graph F



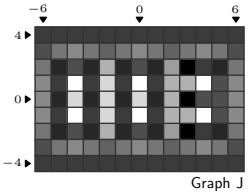
Graph G



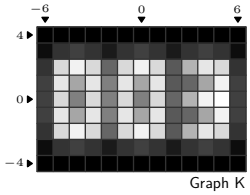
Graph H



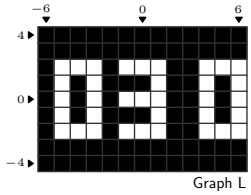
Graph I



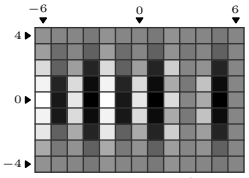
Graph J



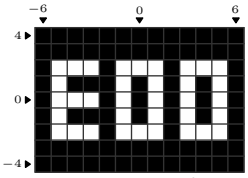
Graph K



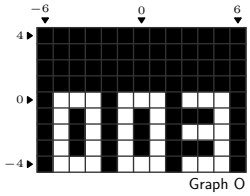
Graph L



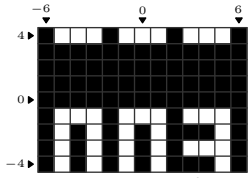
Graph M



Graph N



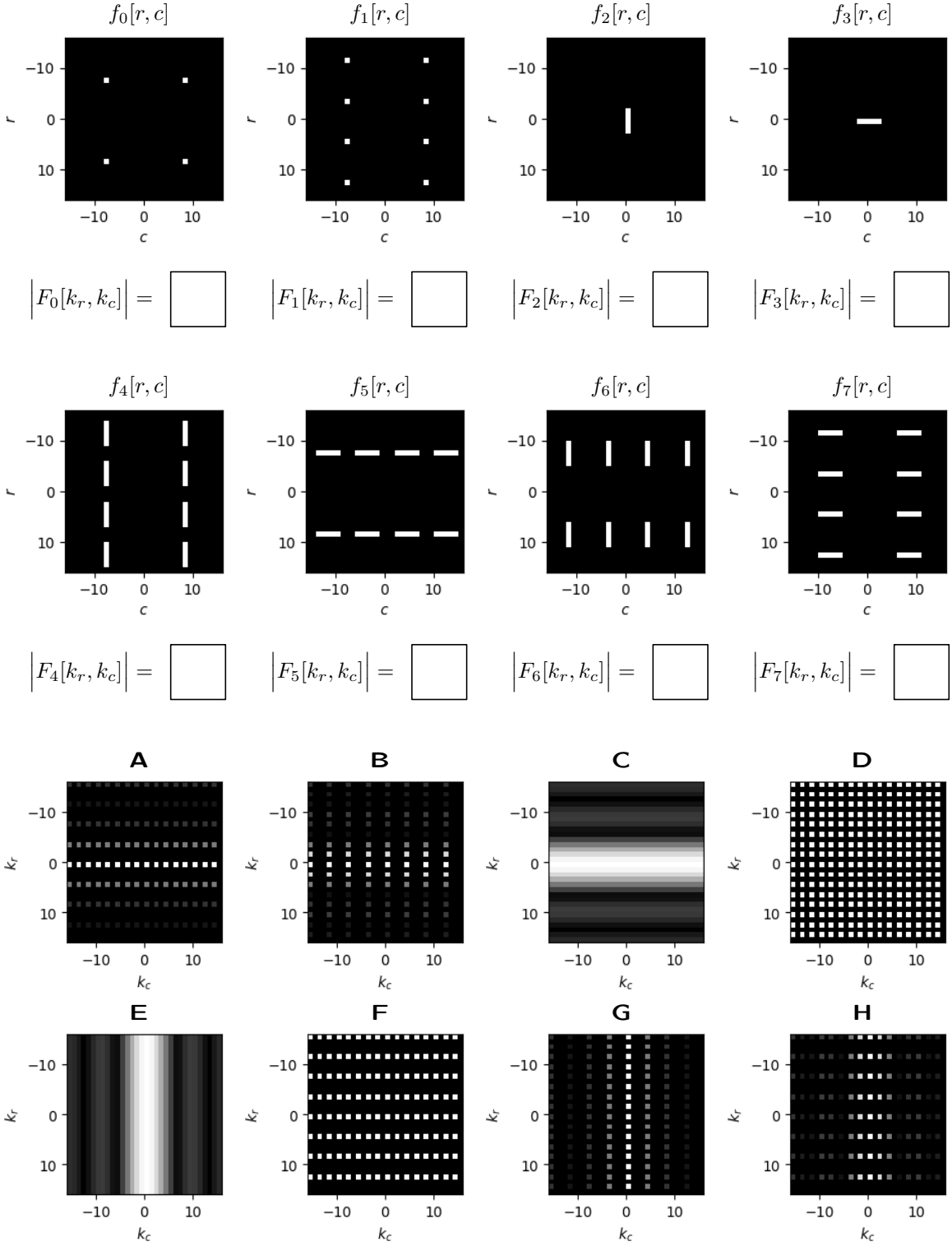
Graph O



Graph P

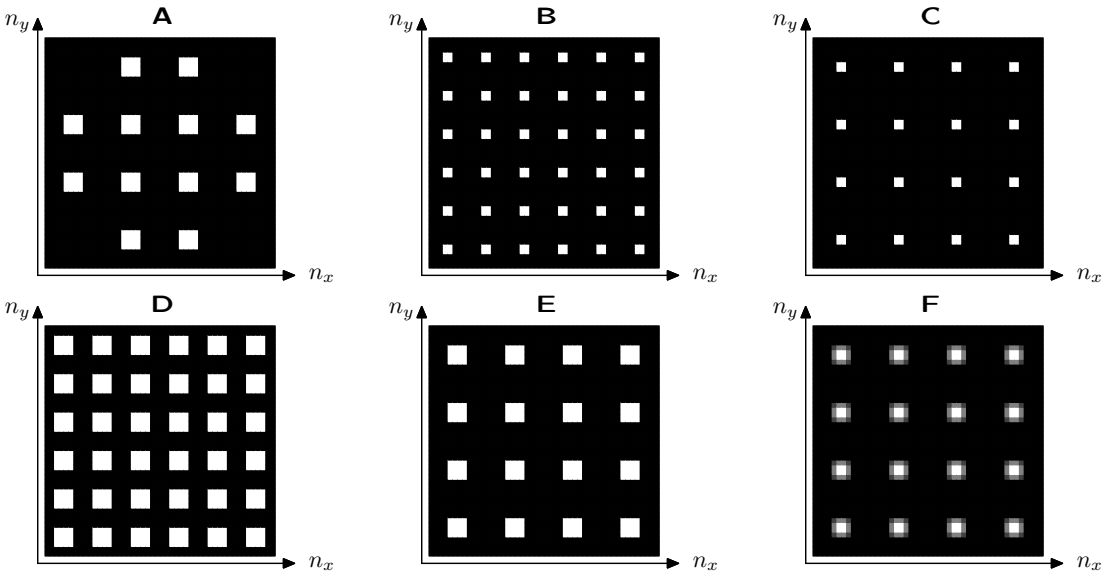
Two-Dimensional Patterns

Match each of the eight 2D signals (each 32×32 pixels) shown in the top eight panels with the magnitude of its 2D DFT (lower panels A-H). Black represents 0. White represents the most positive value in that panel (not necessarily 1).



Squares

Panels A-F illustrate six 2D discrete-time signals. Each signal has 48 rows and 48 columns. Black represents 0 and white represents 1. The origin of each of these panels is in the center of the panel.

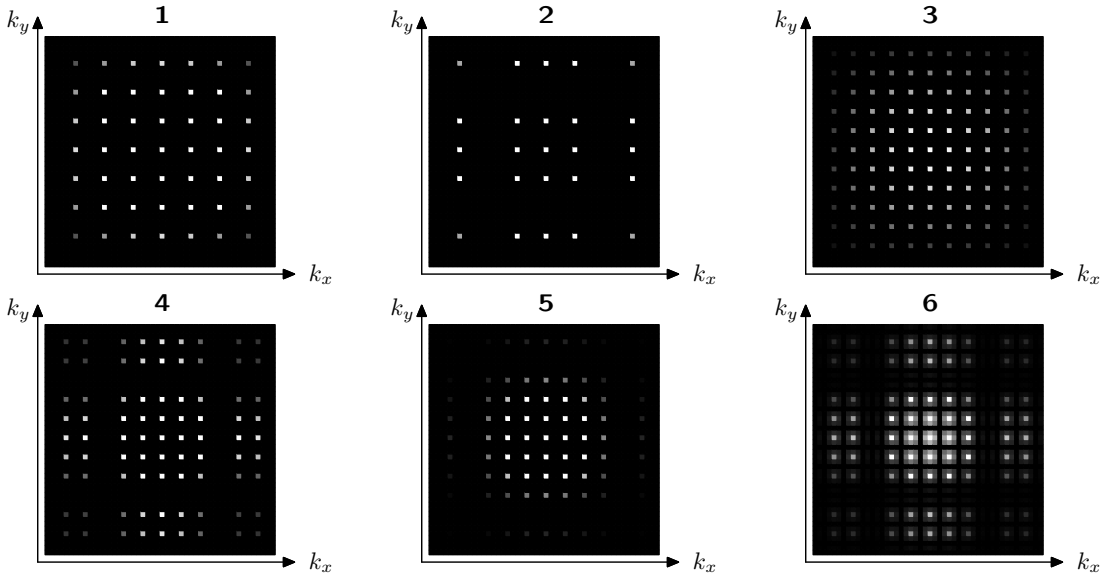


For each signal, determine which of the following panels represents the magnitude of the (48×48) DFT of that signal, where black represents 0 and whiteness is proportional to the magnitude. The origin of each of these panels is in the center of the panel.

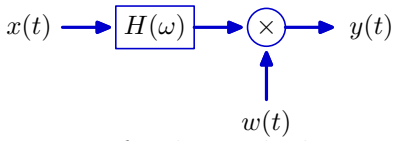
Enter your answers in the boxes below.

A: **B:** **C:**

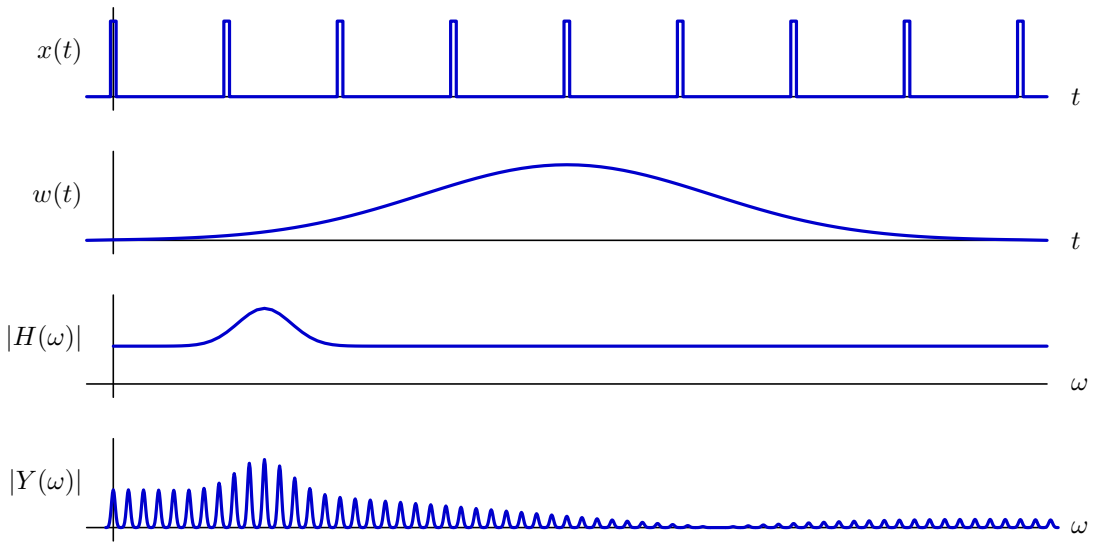
D: **E:** **F:**



1.1 Scaling

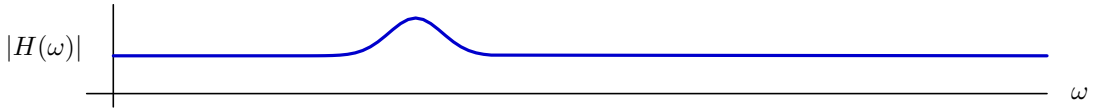


Let $x(t)$ represent an infinite sequence of pulses, which is passed through an LTI filter $H(\omega)$ and then multiplied by $w(t)$ to produce $y(t)$, as shown on the right.

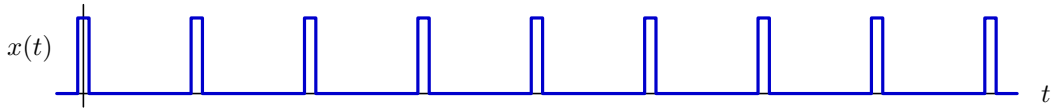


Only one of the previous signals is changed in each of the following parts. Identify the corresponding result from the list on the next page (original $|Y(\omega)|$ shown for reference).

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

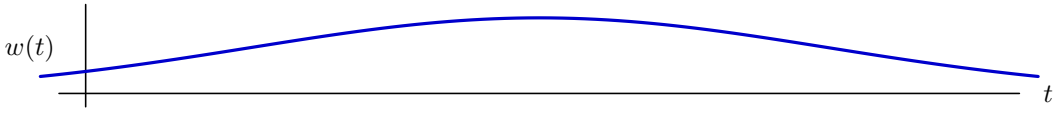


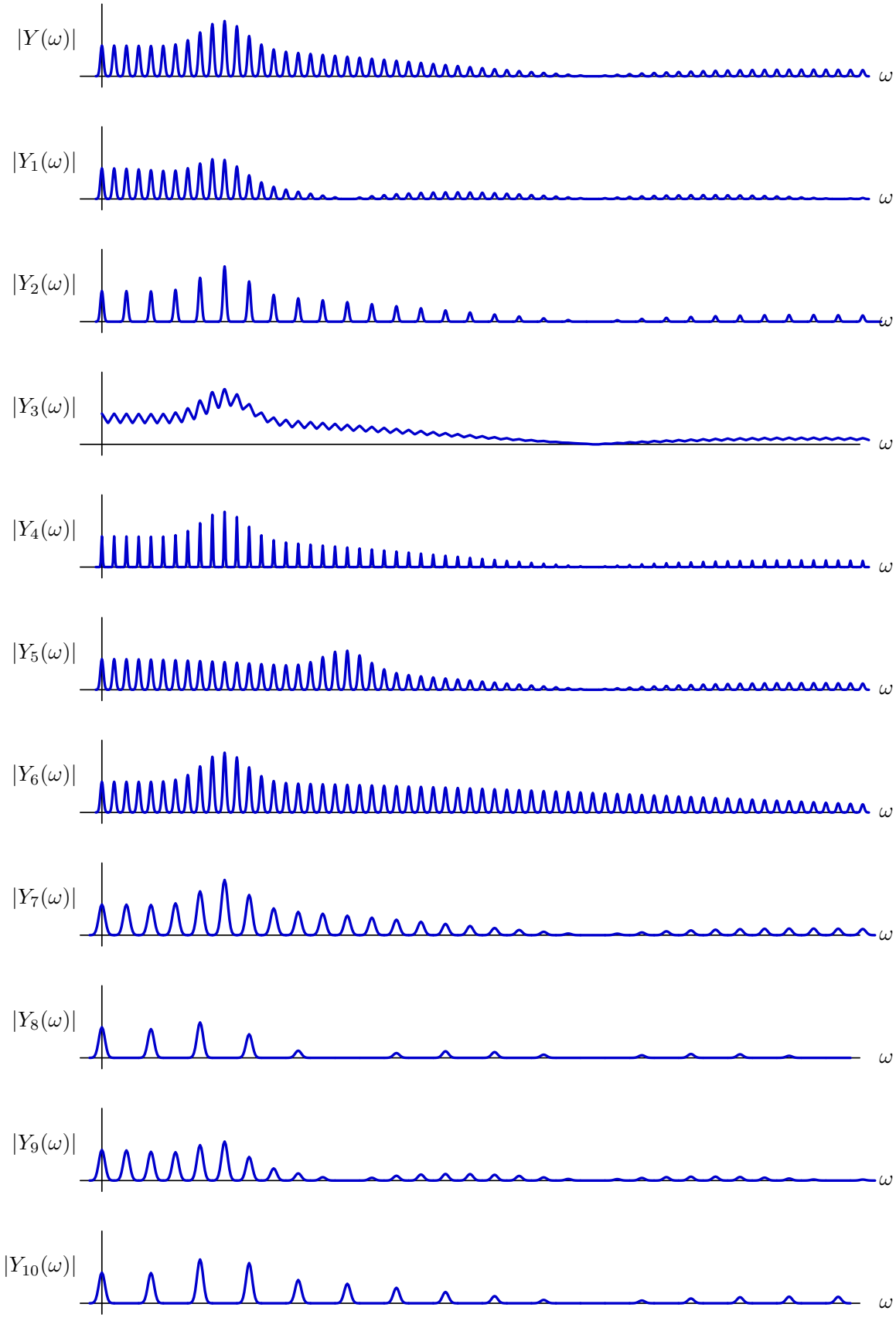
Part b. The duration of each pulse in $x(t)$ is doubled. **1, 2, ... 10,** or **none**: ☐



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**: ☐




$|Y(\omega)|$
ω
$|Y_1(\omega)|$
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$|Y_2(\omega)|$
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$|Y_4(\omega)|$
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$|Y_5(\omega)|$
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