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Quiz #10

1) Assume $x(t) = 3 + 2\cos(2t - 3)$ is the input to an LTI system with transfer function

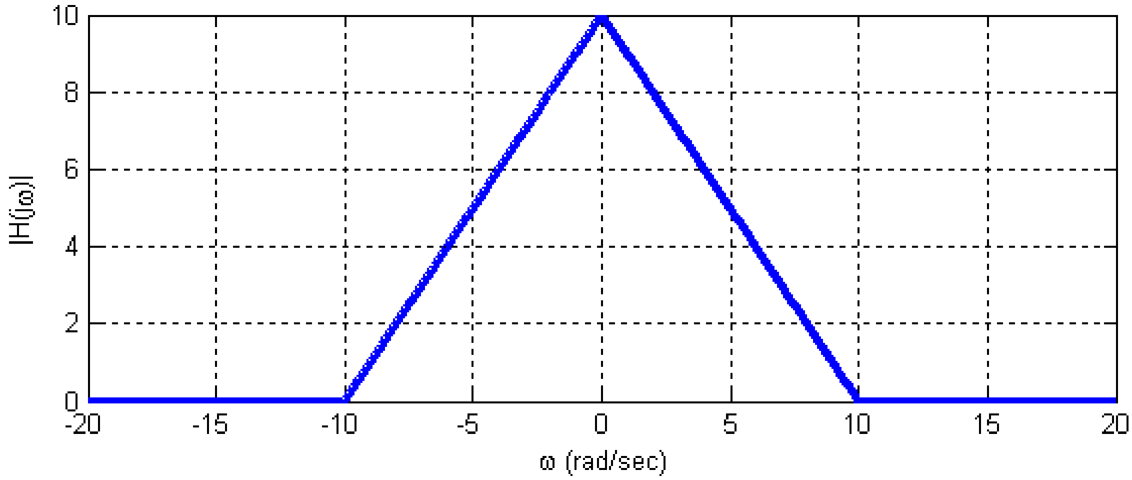
$$H(j\omega) = \begin{cases} 2e^{-j\omega} & |\omega| < 3 \\ 3e^{-j2\omega} & |\omega| \geq 3 \end{cases}$$

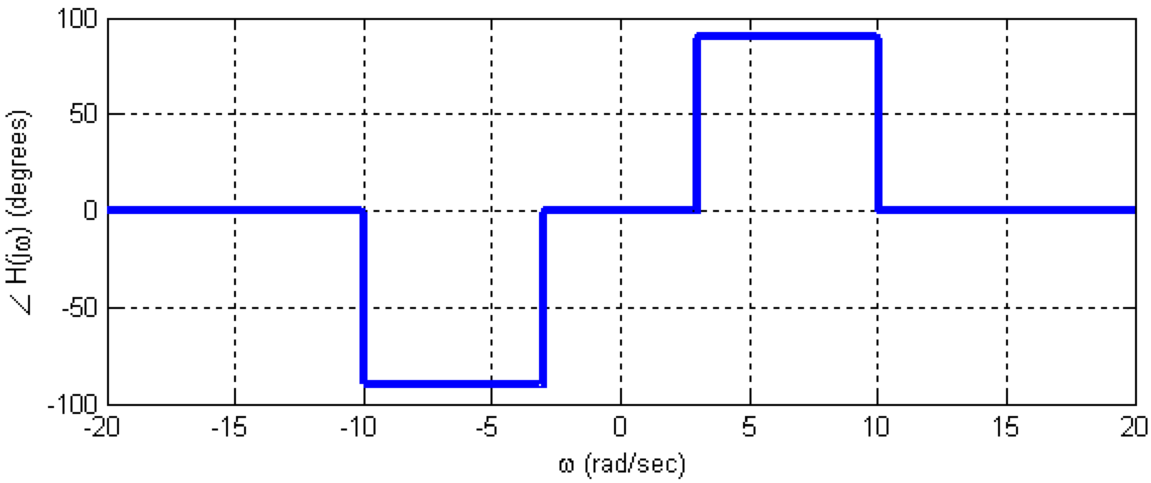
The **steady state output** will be

a) $y(t) = 6 + 4\cos(2t - 5)$ b) $y(t) = 4\cos(2t - 5)$ c) $y(t) = [3 + 2\cos(2t - 3)][2e^{-j\omega}]$

d) $y(t) = 6 + 4\cos(2t - 3)e^{-j2}$ e) $y(t) = 3 + 4\cos(2t - 5)$ f) none of these

2) Assume $x(t) = 2 + \sin(5t) + 3\cos(8t + 30^o)$ is the input to an LTI system with transfer function shown below





The **steady state output** of this system will be

a) $y(t) = 20 + 5\sin(5t + 90^o) + 6\cos(8t + 90^o)$ b) $y(t) = 2 + 5\sin(5t + 90^o) + 6\cos(8t + 90^o)$

c) $y(t) = 20 + 5\sin(5t + 90^o) + 6\cos(8t + 120^o)$ d) $y(t) = 10 + 5\sin(5t + 90^o) + 6\cos(8t + 120^o)$

e) none of these

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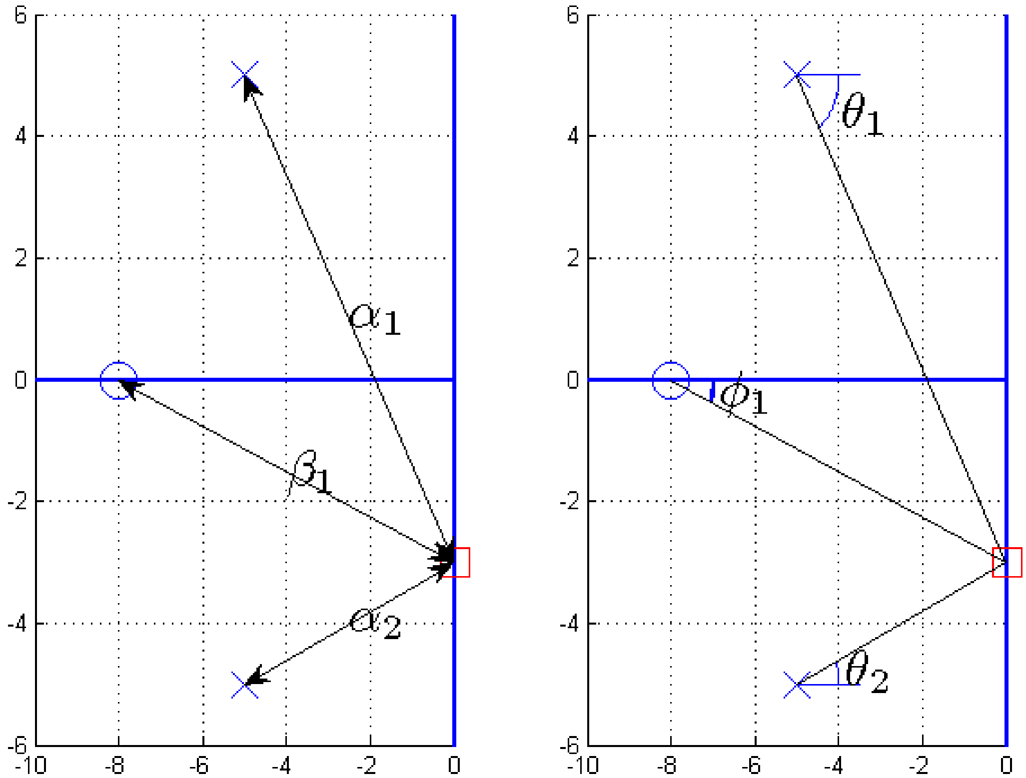
3) The **bandwidth** of the LTI system with transfer function $H(s)=\dfrac{10}{2s+3}$ is

a) 3 rad/sec b) 3 Hz c) 2 rad/sec d) 0.5 Hz e) 1.5 rad/sec f) 1.5 Hz

Problems 4 –7 refer to the following pole-zero diagram that is being used to compute the frequency response of a transfer function.



4) For this transfer function, the frequency response is computed as

a) $H(j\omega_0)=\dfrac{\alpha_1\alpha_2}{\beta_1}\angle(\theta_1+\theta_2-\phi_1)$ b) $H(j\omega_0)=\dfrac{\beta_1}{\alpha_1\alpha_2}\angle(\theta_1+\theta_2-\phi_1)$

c) $H(j\omega_0)=\dfrac{\beta_1}{\alpha_1\alpha_2}\angle(\phi_1-\theta_1-\theta_2)$ d) $H(j\omega_0)=\dfrac{\alpha_1\alpha_2}{\beta_1}\angle(\phi_1-\theta_1-\theta_2)$

5) β_1 is equal to a) $\sqrt{8^2+5^2}$ b) $\sqrt{8^2-5^2}$ c) 3 d) none of these

6) α_2 is equal to a) $\sqrt{5^2+3^2}$ b) $\sqrt{5^2-3^2}$ c) $\sqrt{5^2+2^2}$ d) none of these

7) θ_1 is equal to a) $\tan^{-1}\left(\dfrac{-8}{-5}\right)$ b) $\tan^{-1}\left(\dfrac{-8}{5}\right)$ c) $\tan^{-1}\left(\dfrac{-3}{-8}\right)$ d) none of these

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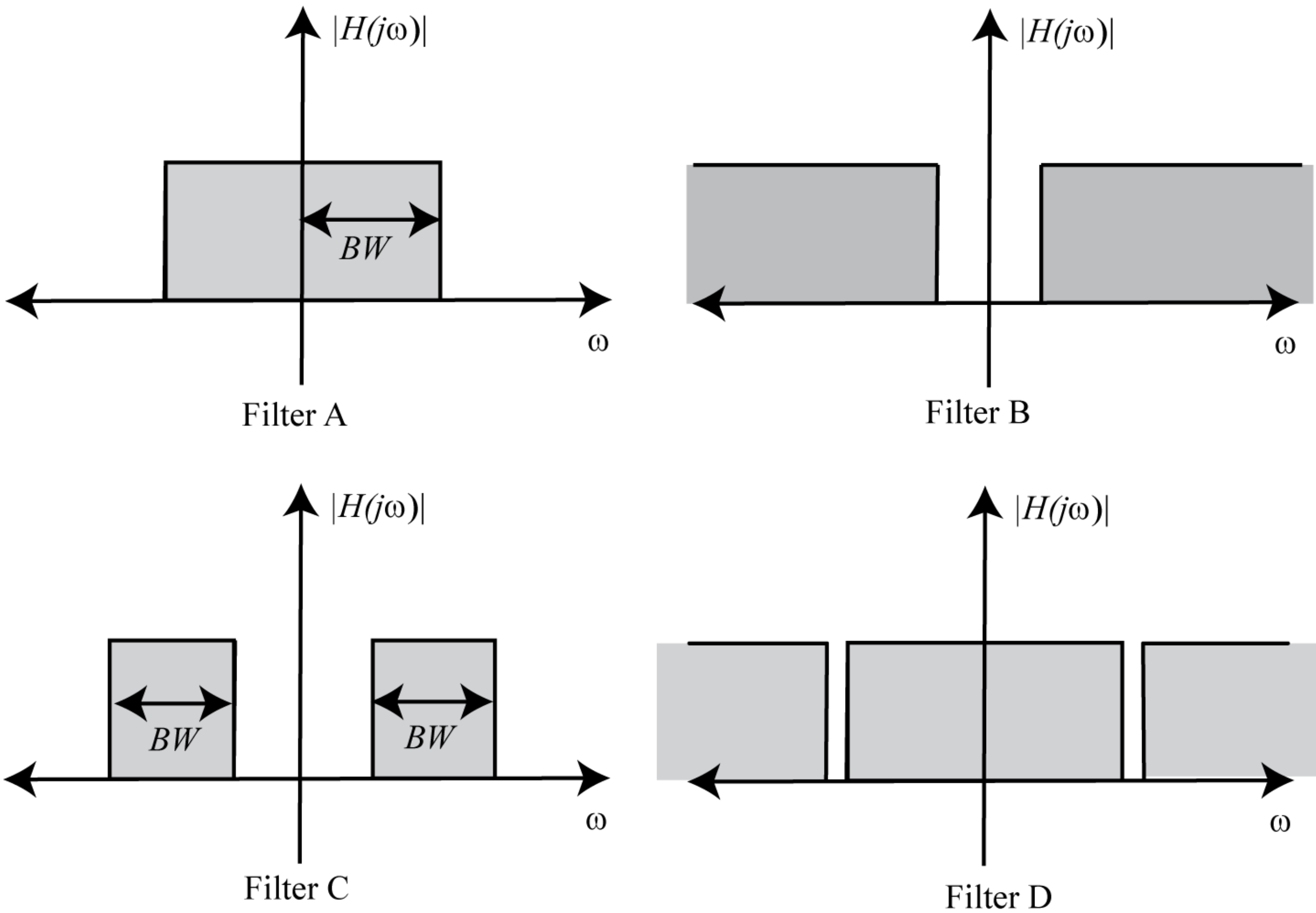
Problems 8-11 refer the representations of ideal filters shown below:



8) Which of these represents a **notch/bandstop** filter? A B C D

9) Which of these represents a **highpass** filter ? A B C D

10) Which of these represents a **lowpass** filter? A B C D

11) Which of these represents a **bandpass** filter? A B C D

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Problems 12 and 13 refer to a system whose frequency response is represented by the Bode plot below.

12) If the input to the system is $x(t) = 5\cos(10t + 30^o)$, then the steady state output is best estimated as

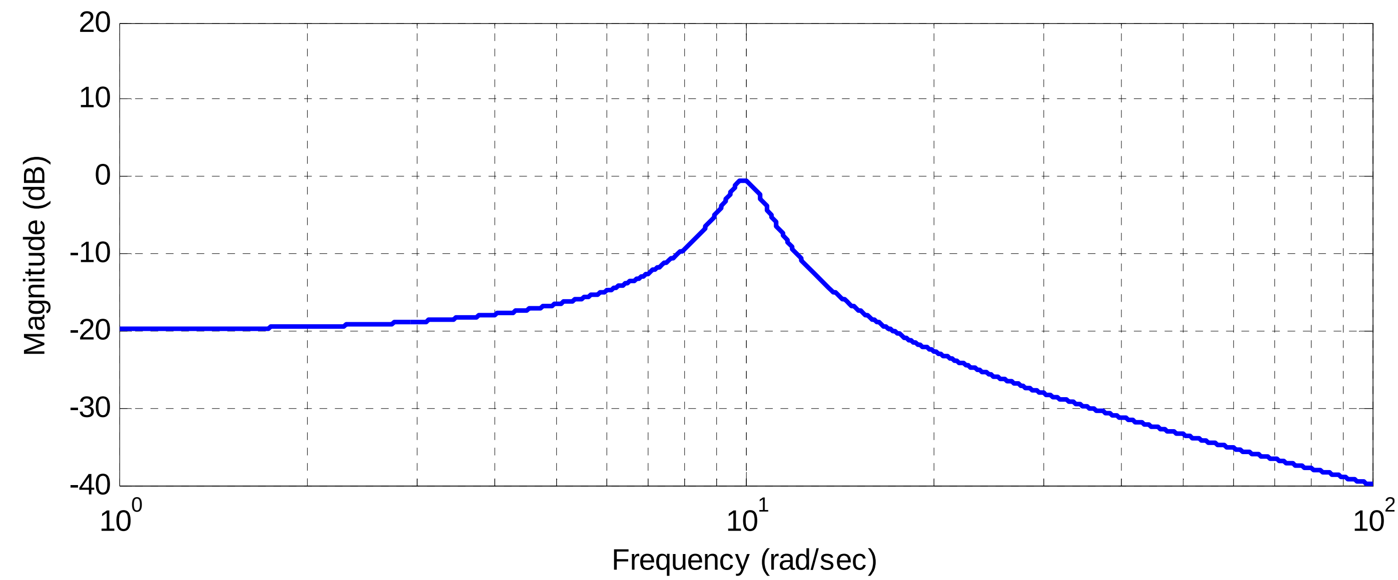
a) $y_{ss}(t) = 0$ b) $y_{ss}(t) = 5\cos(10t + 30^o)$

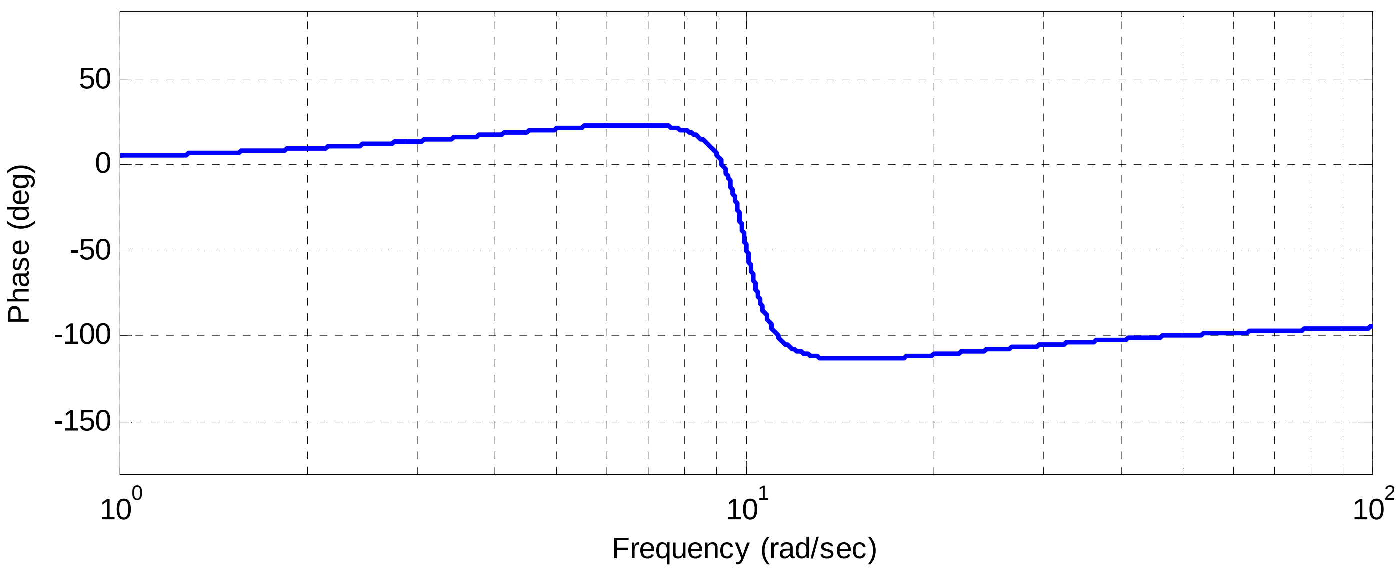
c) $y_{ss}(t) = 5\cos(10t - 20^o)$ d) $y_{ss}(t) = 5\cos(10t - 50^o)$

13) If the input to the system is $x(t) = 50\sin(100t)$, then the steady state output is best estimated as

a) $y_{ss}(t) = -2000\sin(100t - 100^o)$ b) $y_{ss}(t) = 0.5\sin(100t - 100^o)$

c) $y_{ss}(t) = 2000\sin(100t - 100^o)$ d) $y_{ss}(t) = 5\sin(100t - 100^o)$





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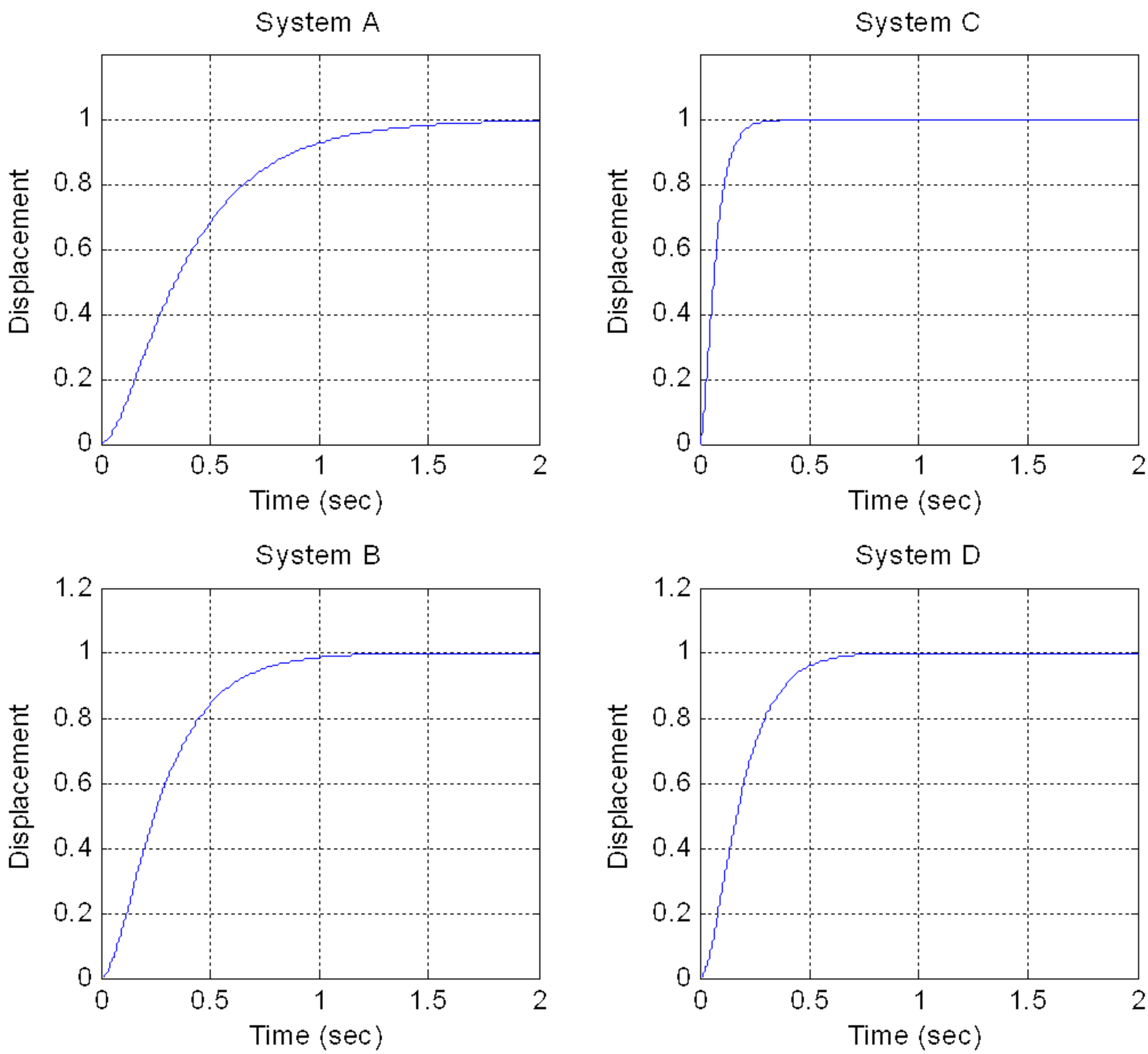
14) The unit step responses of four systems with real poles is shown below. Which system will have the **largest bandwidth**?

a) System A b) System B c) System C d) System D



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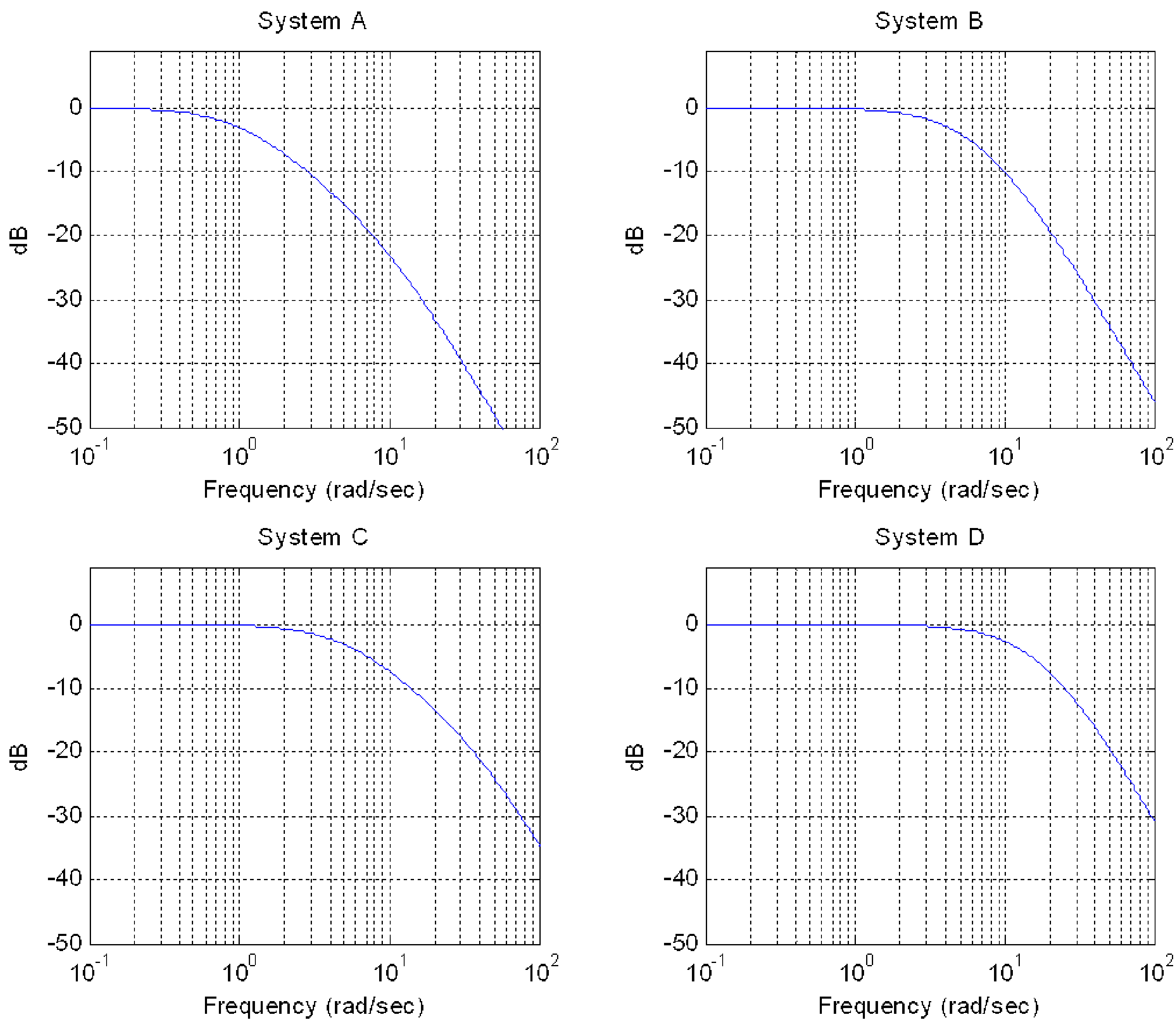
15) The magnitude of the frequency response of four systems with real poles is shown below. Which system will have the smallest **settling time**?

a) System A b) System B c) System C d) System D



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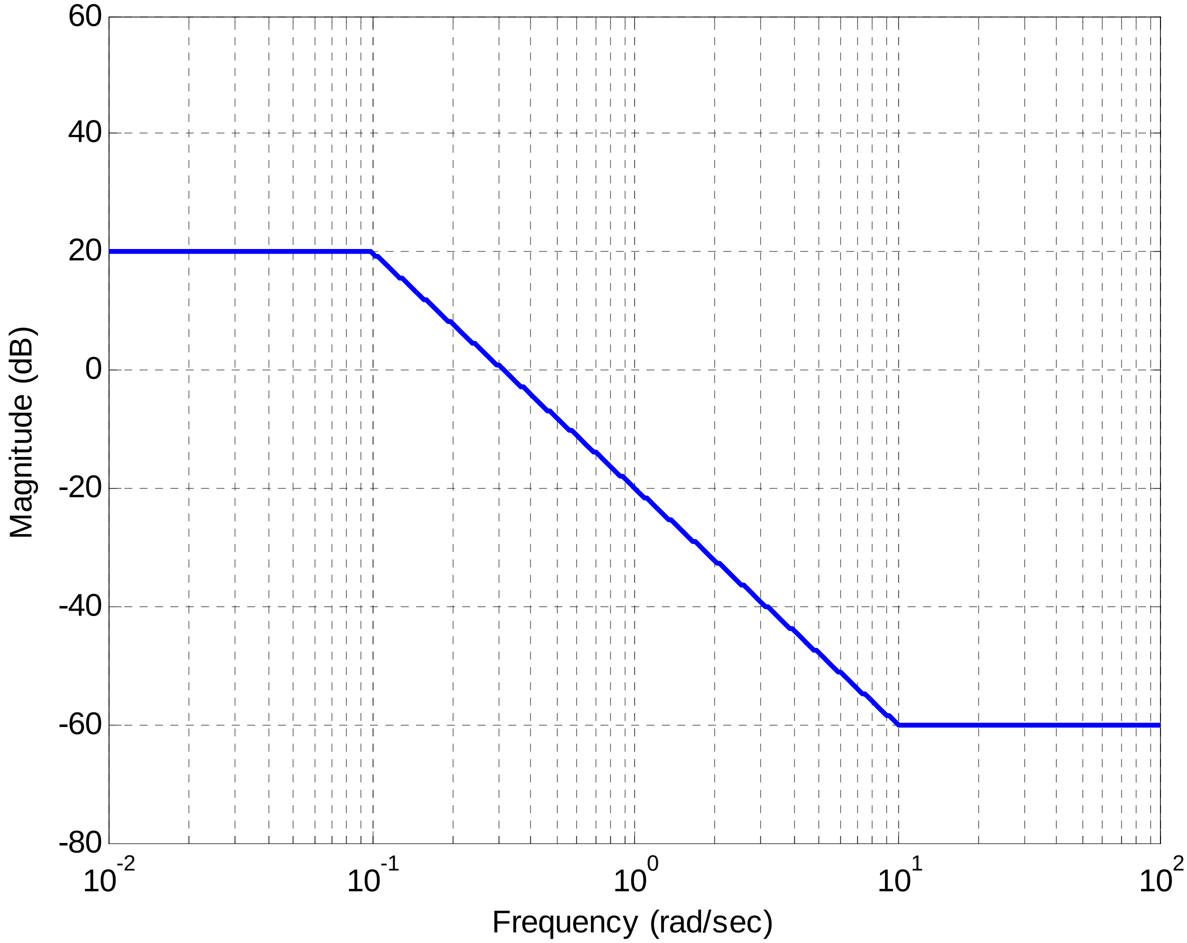
16) For the straight line approximation to the magnitude portion of a Bode plot shown below, the best estimate of the corresponding transfer function is

a) $H(s) = \dfrac{20\left(\frac{1}{10}s+1\right)}{10s+1}$ b) $H(s) = \dfrac{10\left(\frac{1}{10}s+1\right)}{10s+1}$

c) $H(s) = \dfrac{10\left(\frac{1}{10}s+1\right)}{(10s+1)^2}$ d) $H(s) = \dfrac{10\left(\frac{1}{10}s+1\right)^2}{(10s+1)^2}$



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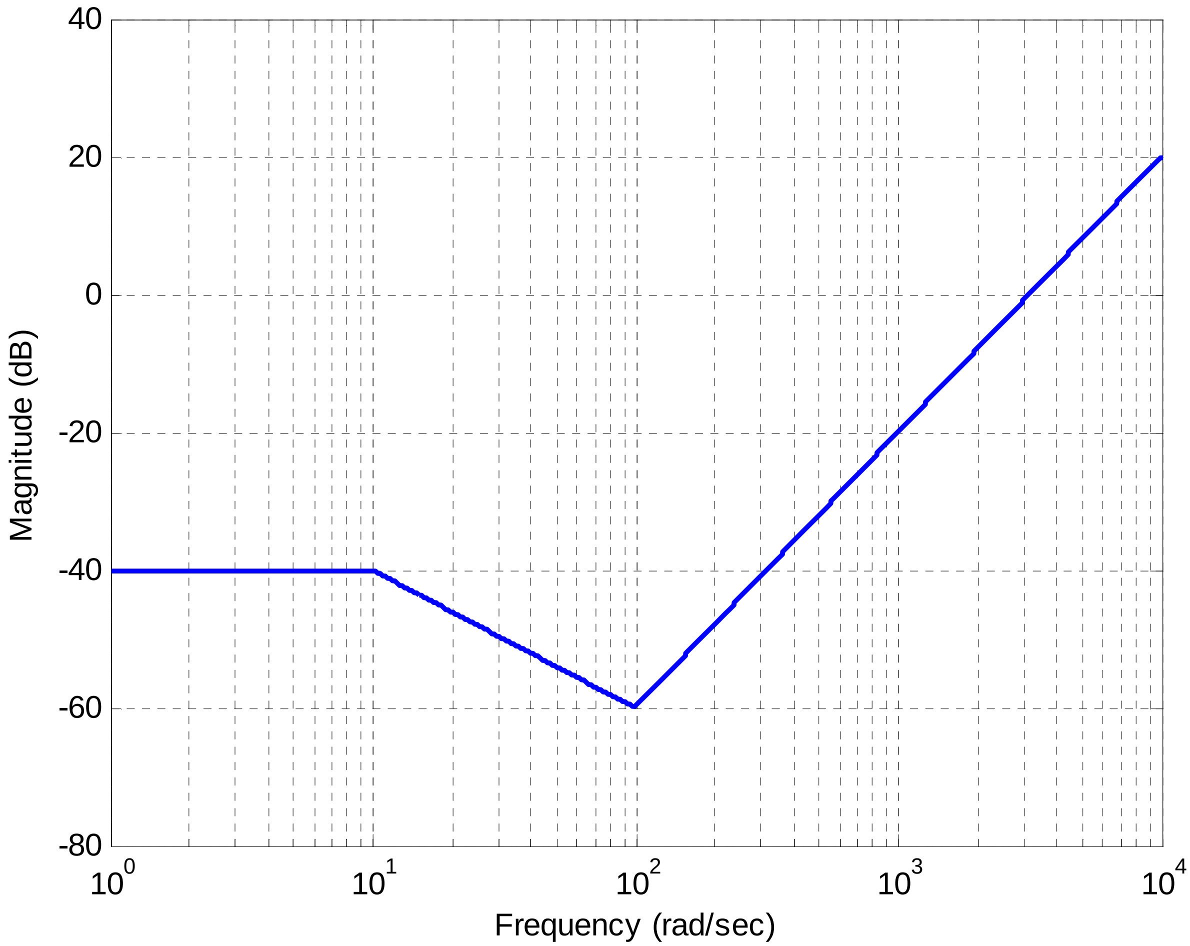
17) For the straight line approximation to the magnitude portion of a Bode plot shown below, the best estimate of the corresponding transfer function is

a) $H(s)=\dfrac{0.01\left(\frac{1}{100}s+1\right)^2}{\left(\frac{1}{10}s+1\right)}$ b) $H(s)=\dfrac{-40\left(\frac{1}{100}s+1\right)^2}{\left(\frac{1}{10}s+1\right)}$

c) $H(s)=\dfrac{0.01\left(\frac{1}{100}s+1\right)^3}{\left(\frac{1}{10}s+1\right)}$ d) $H(s)=\dfrac{0.01\left(\frac{1}{100}s+1\right)^3}{\left(\frac{1}{10}s+1\right)^2}$



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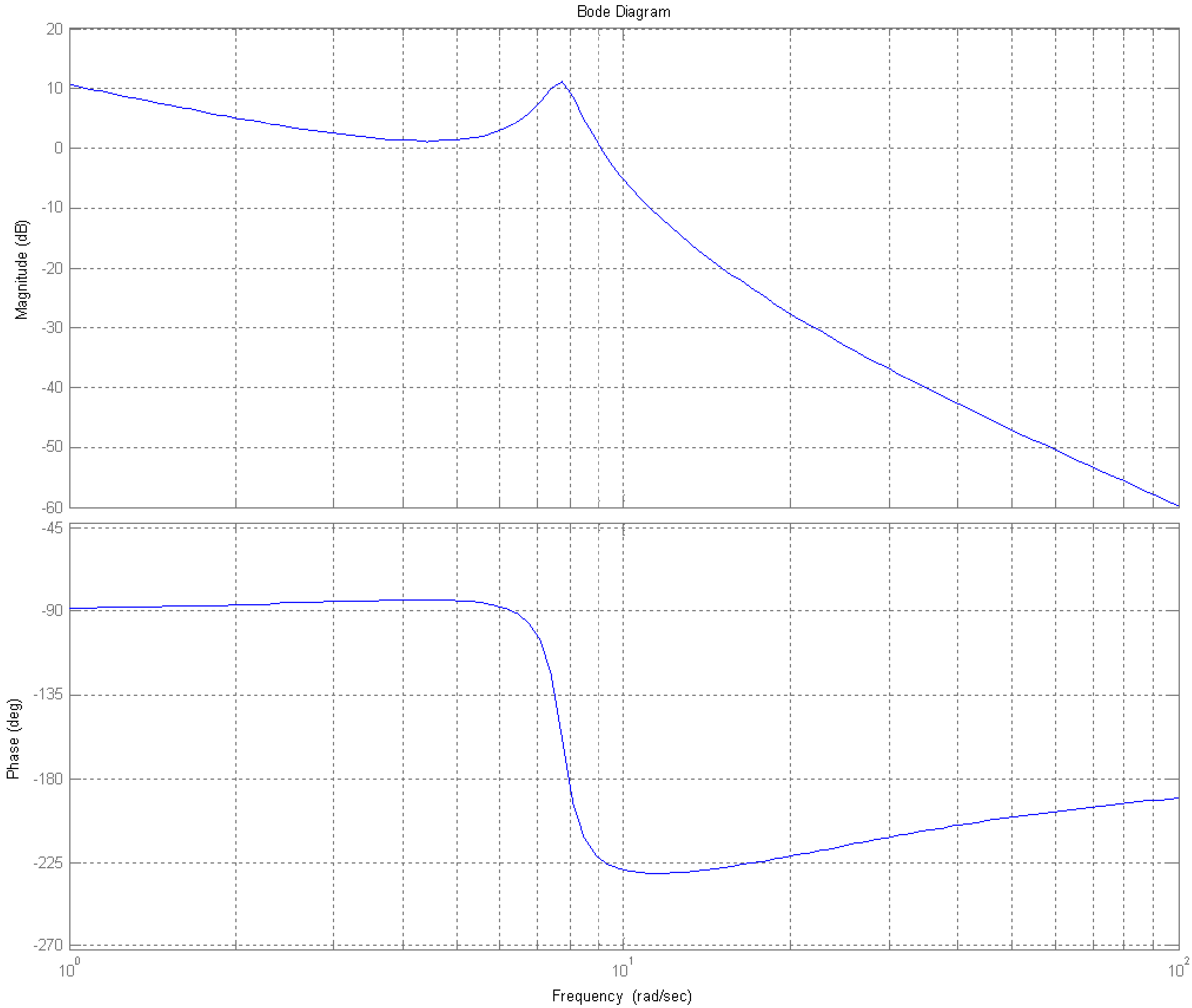
Problems 18-21 refer to the following open loop Bode plot of $G(s)H(s)$.



18) The *gain crossover frequency used to determine the phase margin* for this system is best estimated as

a) 9 rad/sec b) 8 rad/sec c) 7.5 rad/sec d) 1 rad/sec e) 10 rad/sec

19) The *phase crossover frequency* for this system is best estimated as

a) 9 rad/sec b) 8 rad/sec c) 7.5 rad/sec d) 1 rad/sec e) 10 rad/sec

20) The phase margin for this system is best estimated as a) $+45^o$ b) -45^o c) $+135^o$ d) -135^o

21) The gain margin for this system is best estimated as a) +10 dB b) - 10 dB c) ∞ dB d) 7 dB