Problem 9.18 Generate Bode magnitude and phase plots (straight-line approximation) for the following voltage transfer functions:

(a) $\mathbf{H}(\omega) = \dfrac{30(10+j\omega)}{(200+j2\omega)(1000+j2\omega)}$

(b) $\mathbf{H}(\omega) = \dfrac{j100\omega}{(100+j5\omega)(100+j\omega)^2}$

(c) $\mathbf{H}(\omega) = \dfrac{(200+j2\omega)}{(50+j5\omega)(1000+j\omega)}$

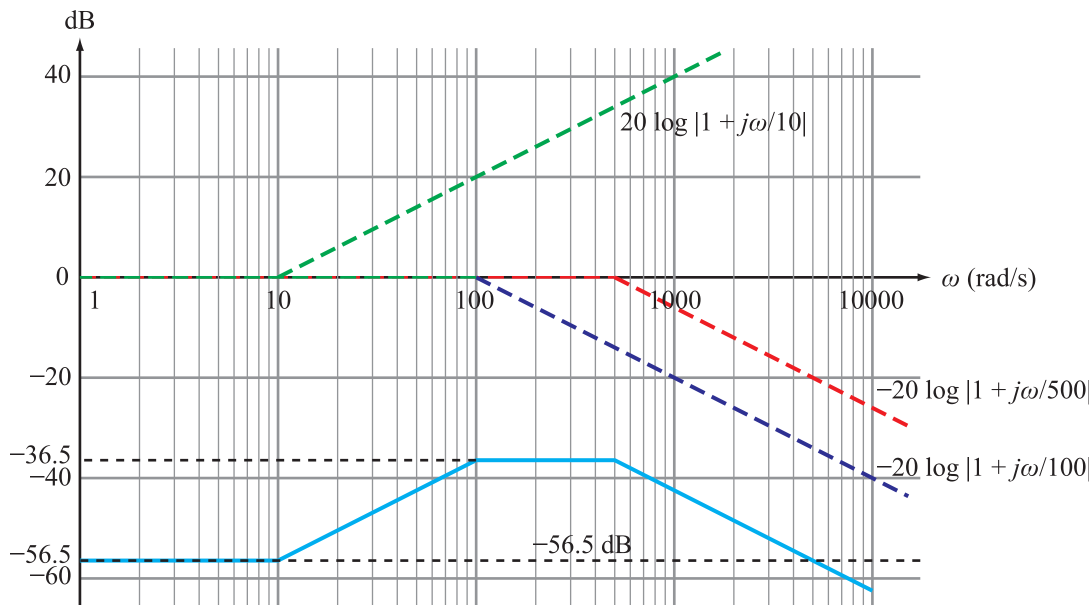
Solution:

(a)

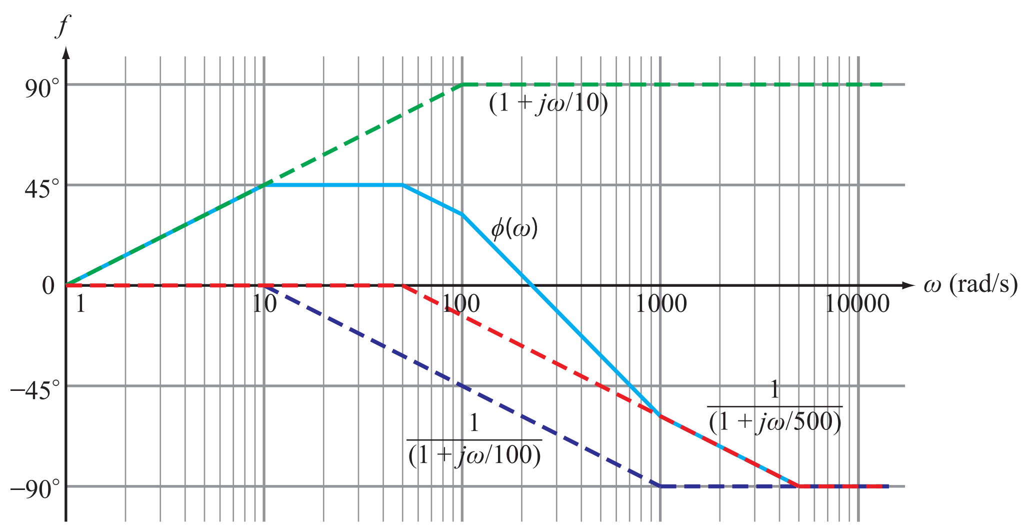
$$\mathbf{H}_{(}\omega) = \frac{30(10+j\omega)}{(200+j2\omega)(1000+j2\omega)} = \frac{300(1+j\omega/10)}{200\times 1000(1+j\omega/100)(1+j\omega/500)}$$

$$= \frac{1.5\times 10^{-3}(1+j\omega/10)}{(1+j\omega/100)(1+j\omega/500)}$$

- Constant term $1.5\times 10^{-3} \quad \Longrightarrow \quad -56.5$ dB
- Simple zero with $\omega_c = 10$ rad/s
- Simple pole with $\omega_c = 100$ rad/s
- Simple pole with $\omega_c = 500$ rad/s



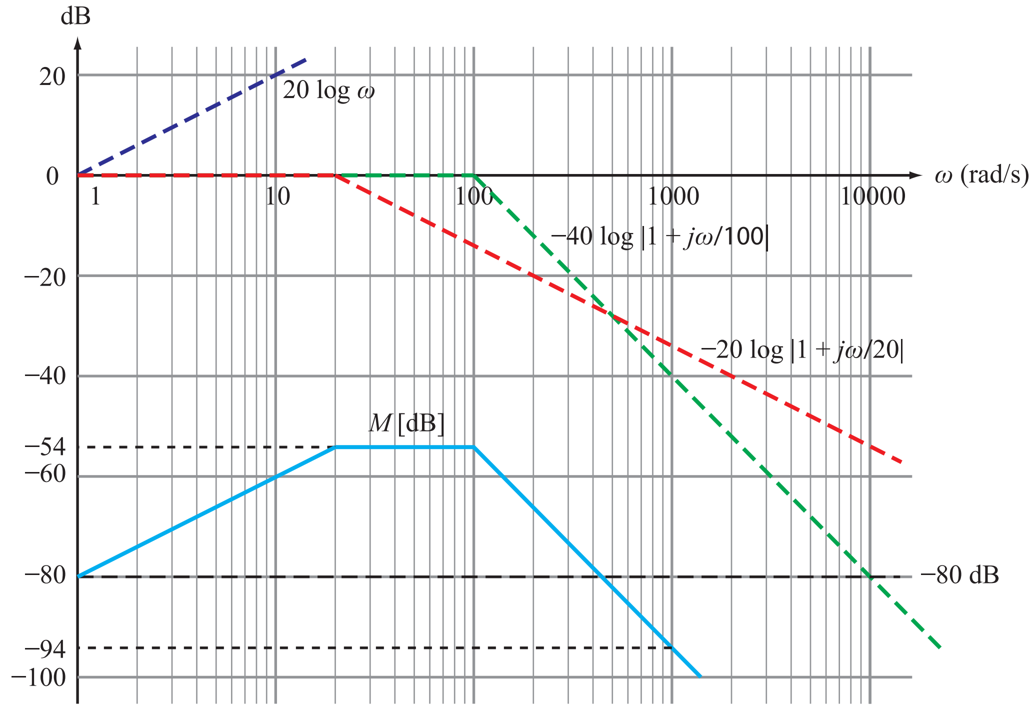
Magnitude



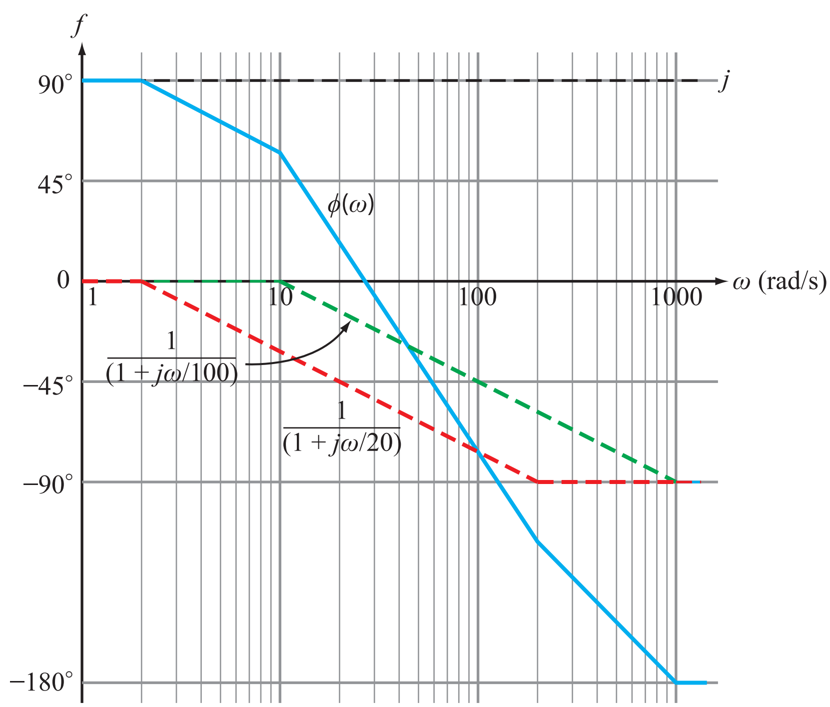
Phase

(b) $\mathbf{H}(\omega) = \dfrac{j100\omega}{(100 + j5\omega)(100 + j\omega)^2} = \dfrac{j10^{-4}\omega}{(1 + j\omega/20)(1 + j\omega/100)^2}$

- Constant term $10^{-4} \implies -80$ dB
- Zero @ origin
- Simple pole with $\omega_c = 20$ rad/s
- Simple pole with $\omega_c = 100$ rad/s, of order 2



Magnitude



Phase

(c) $\mathbf{H}(\omega) = \dfrac{(200 + j2\omega)}{(50 + j5\omega)(1000 + j\omega)} = \dfrac{(1 + j\omega/100)}{250(1 + j\omega/10)(1 + j\omega/1000)}$

- Constant term $1/250 \implies -48$ dB
- Simple pole with $\omega_c = 10$ rad/s

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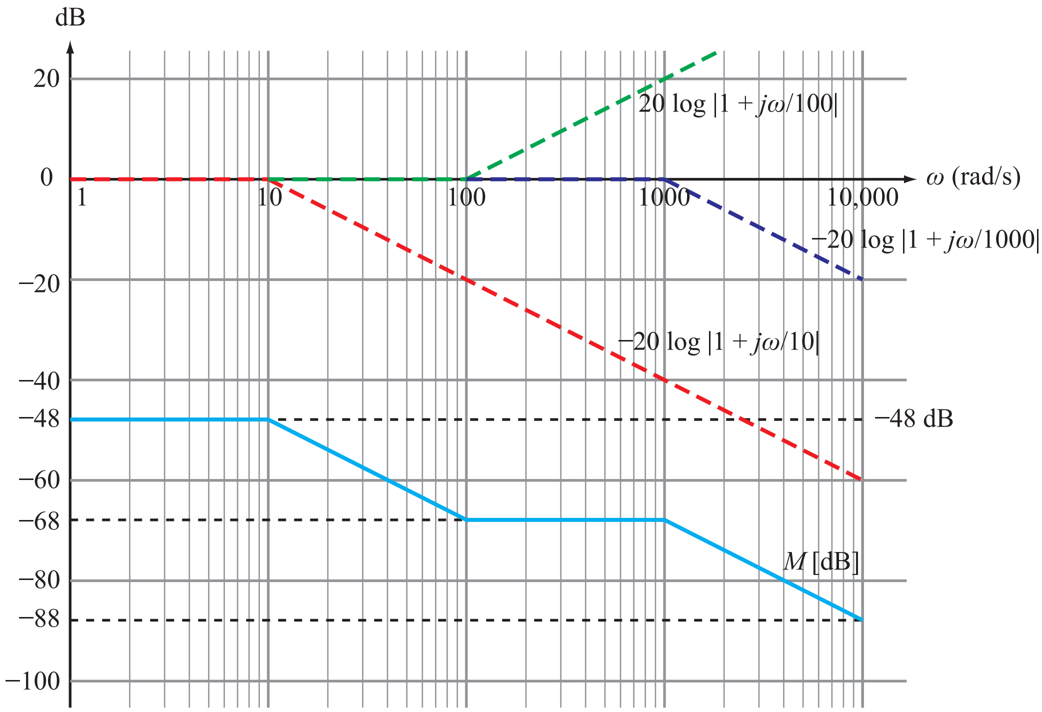
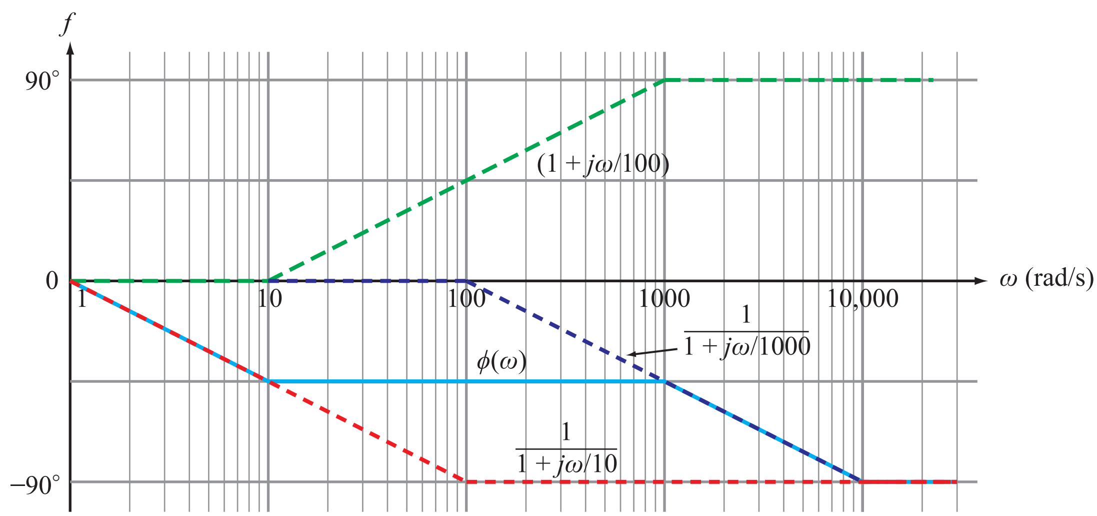


Magnitude



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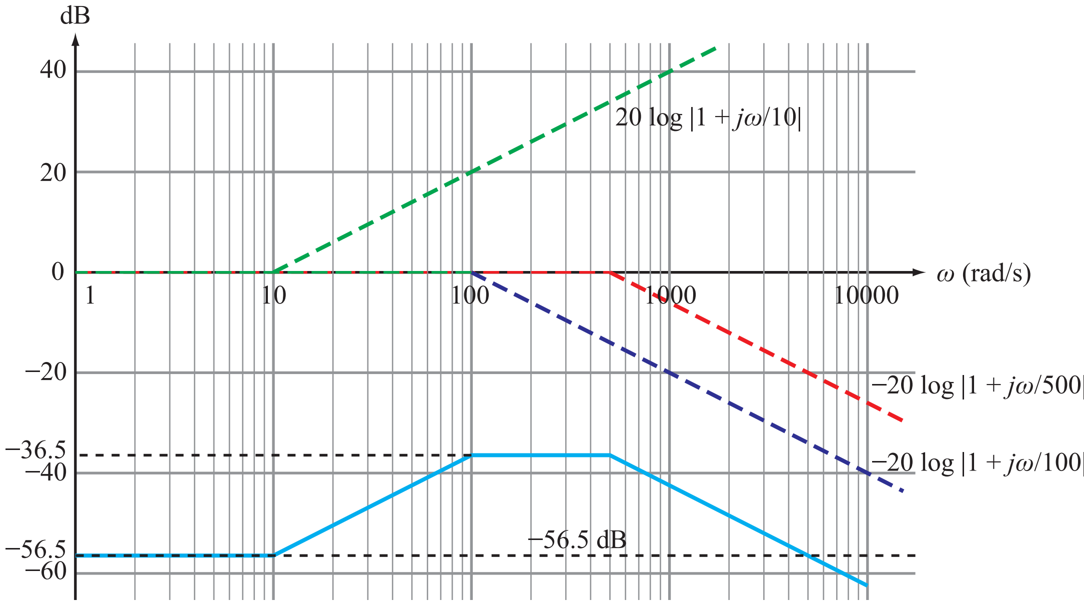
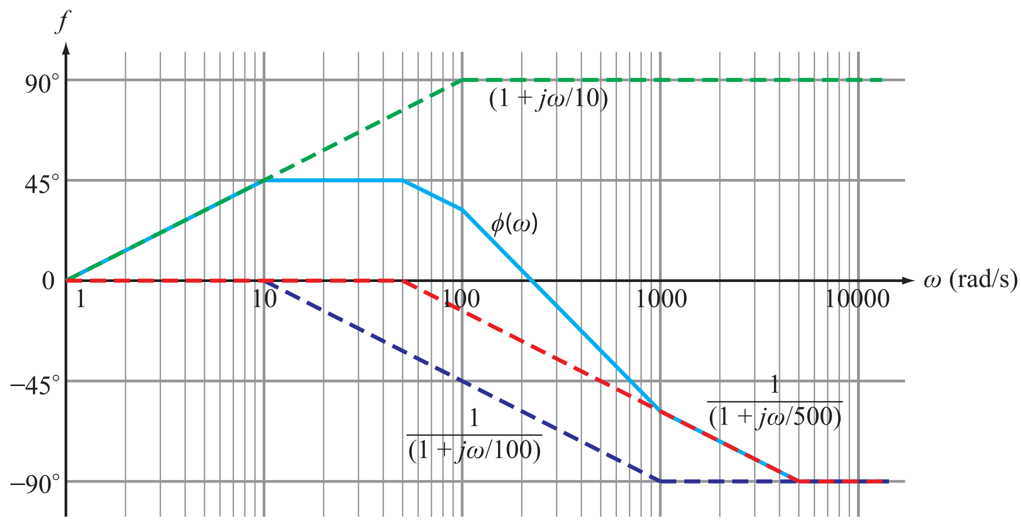


Magnitude



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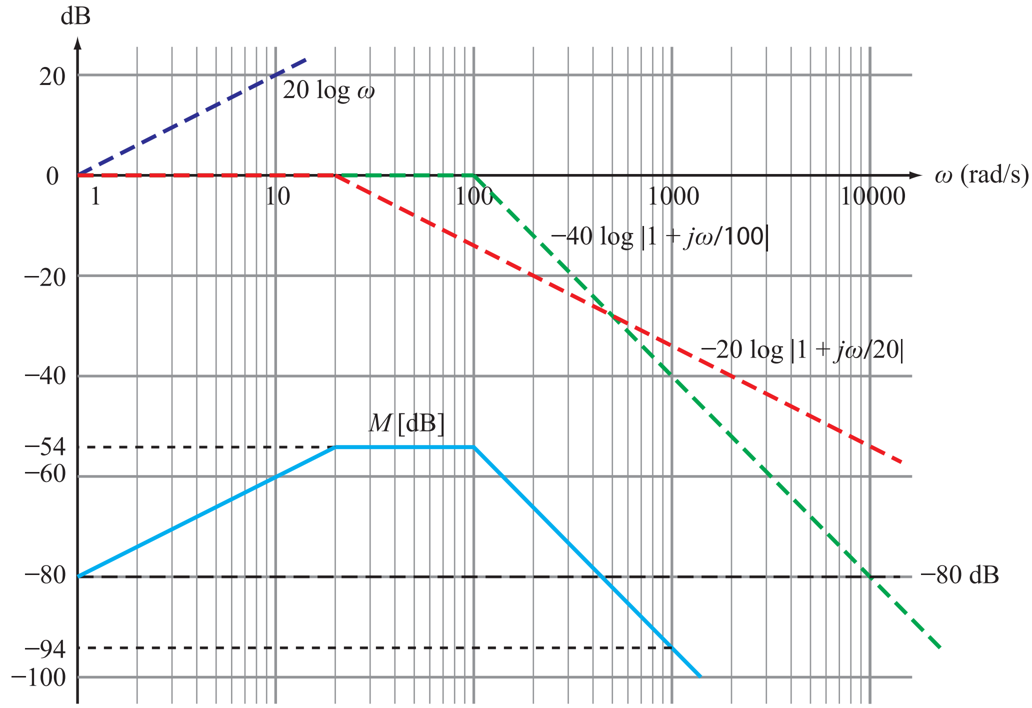

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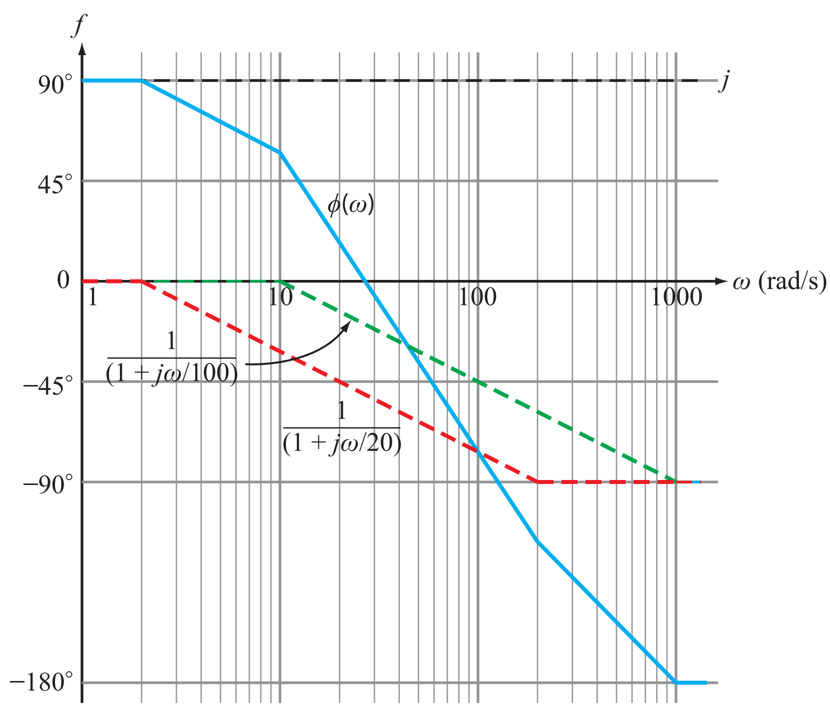

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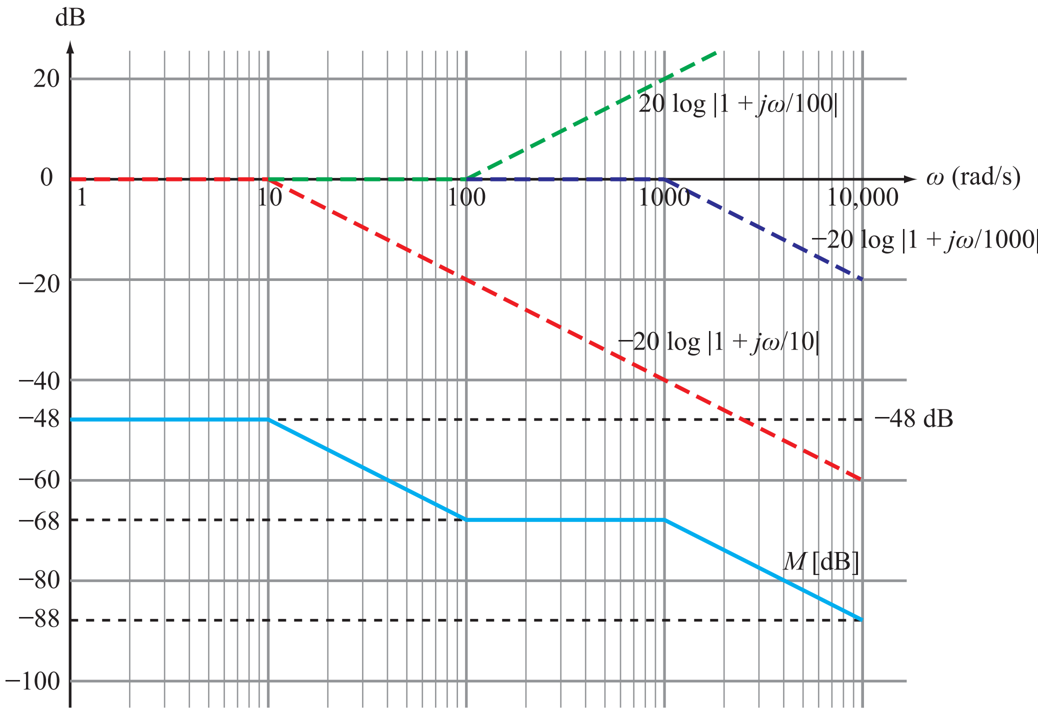
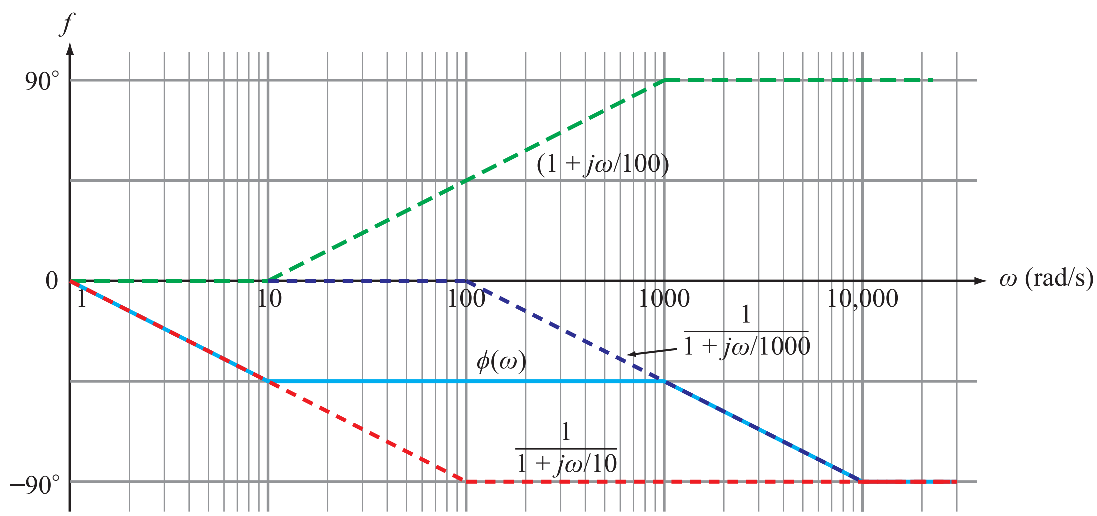


Magnitude



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