

S & S Homework Solutions

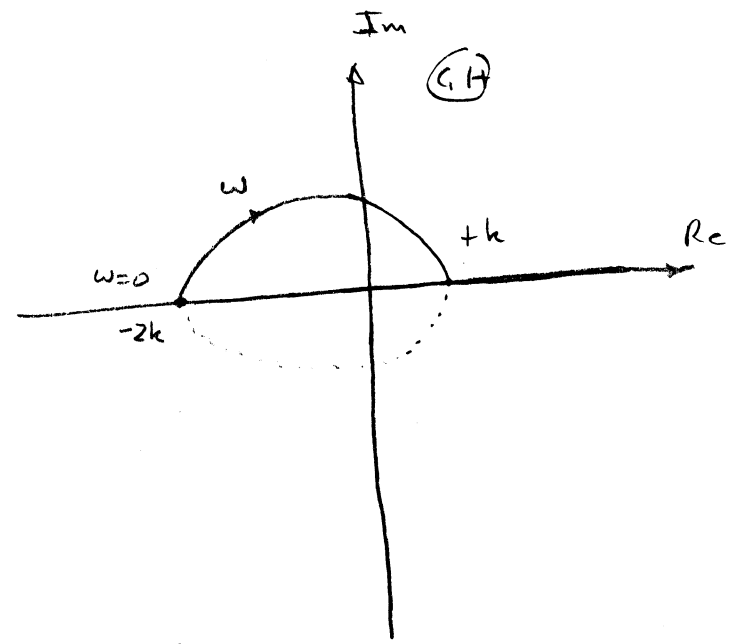
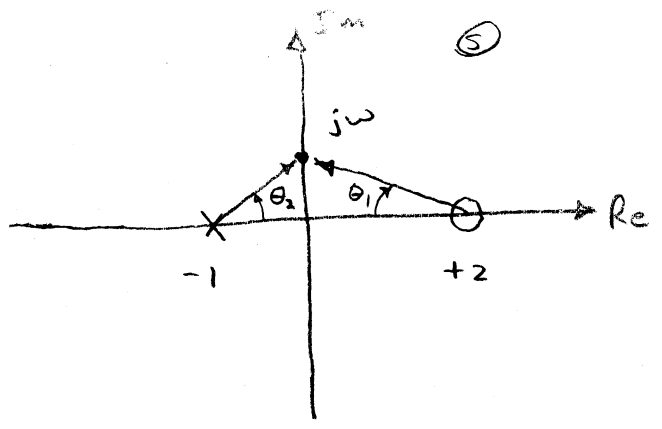
517) a) $G(s)H(s) = \frac{k(s-2)}{(s+1)}$

zero at $s=+2$

pole at -1

ω	$ GH $	$\angle GH$
0	$2k$	$-\pi = -180^\circ$
∞	k	0

$$G(j\omega)H(j\omega) = \frac{k(j\omega-2)}{(j\omega+1)}$$



System at the edge of instability for $k = \frac{1}{2}$

b) $G(s)H(s) = \frac{k(s-3)}{(s^2+3s+2)} = \frac{k(s-3)}{(s+1)(s+2)}$ $k > 0$

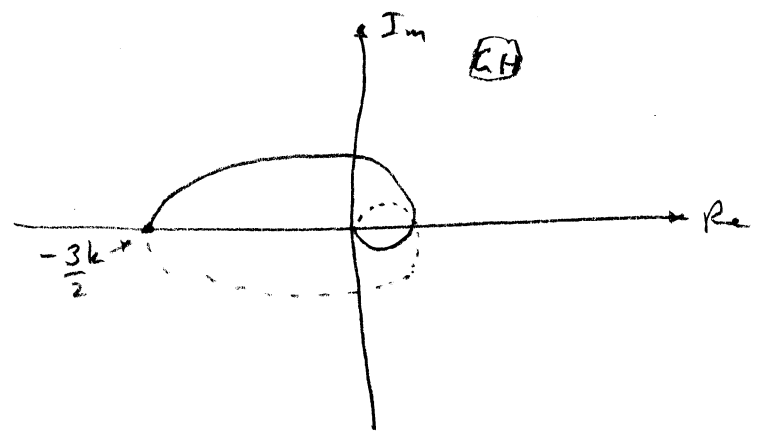
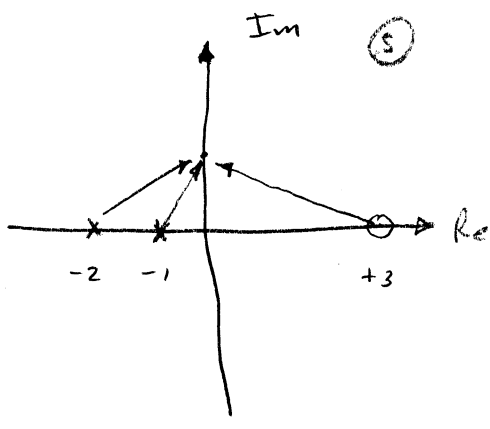
zero at +3

pole at -2

pole at -1

$$G(j\omega)H(j\omega) = \frac{k(j\omega-3)}{(j\omega+1)(j\omega+2)}$$

ω	$ GH $	$\angle GH$
0	$\frac{3k}{2}$	$-\pi = -180^\circ$
∞	0	$-\frac{\pi}{2} = -90^\circ$



System at the edge of stability for $k = \frac{2}{3}$

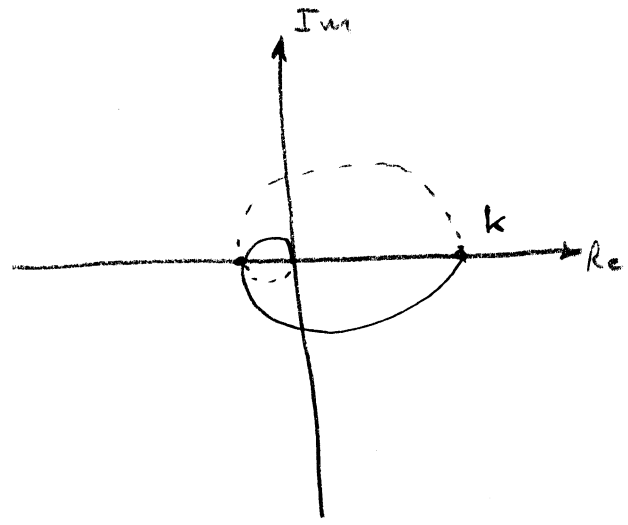
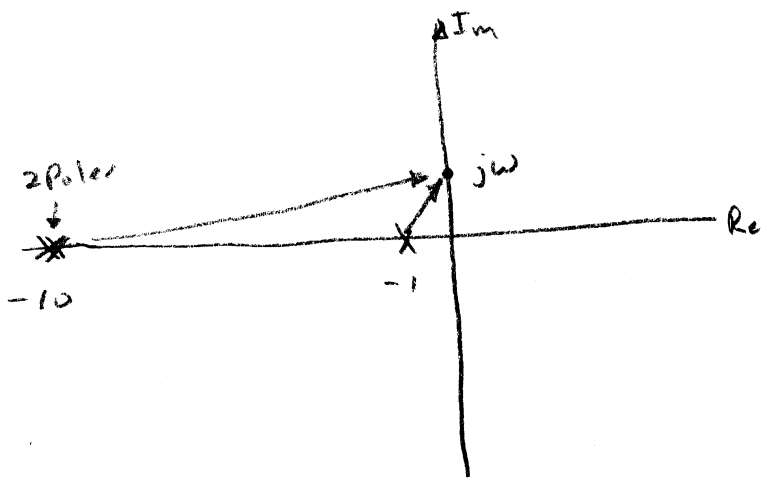
S18)

$$H(s) = \frac{100k}{(s+1)(s+10)^2}$$

$$H(j\omega) = \frac{100k}{(j\omega+1)(j\omega+10)^2}$$

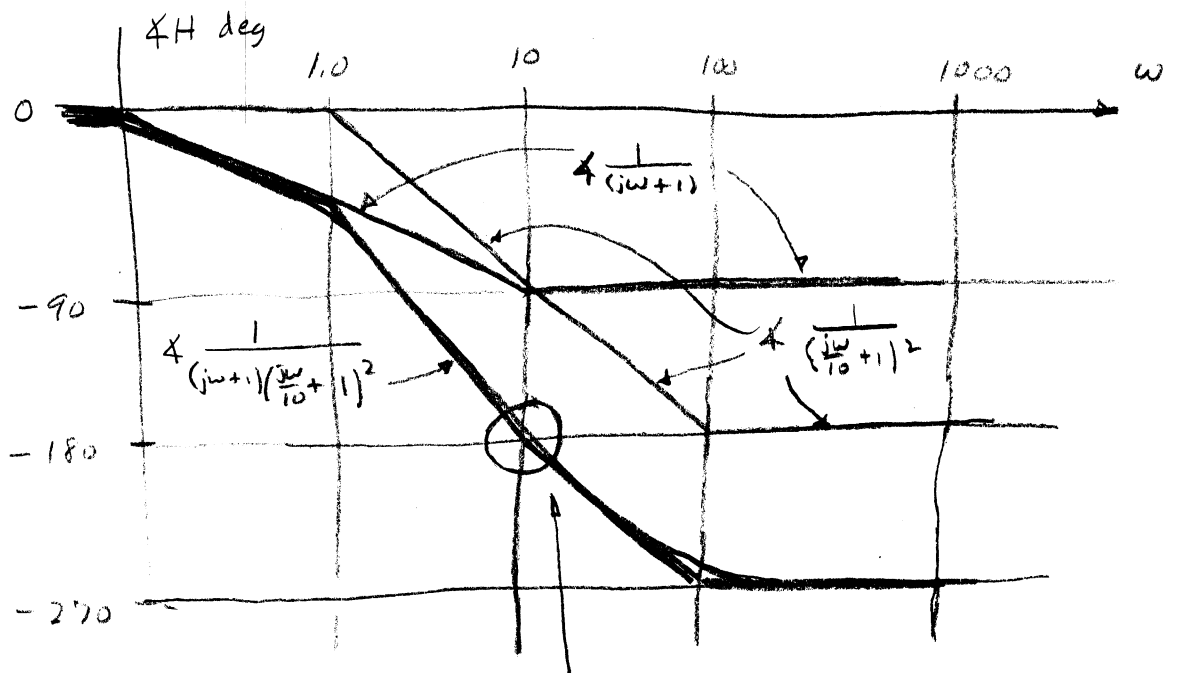
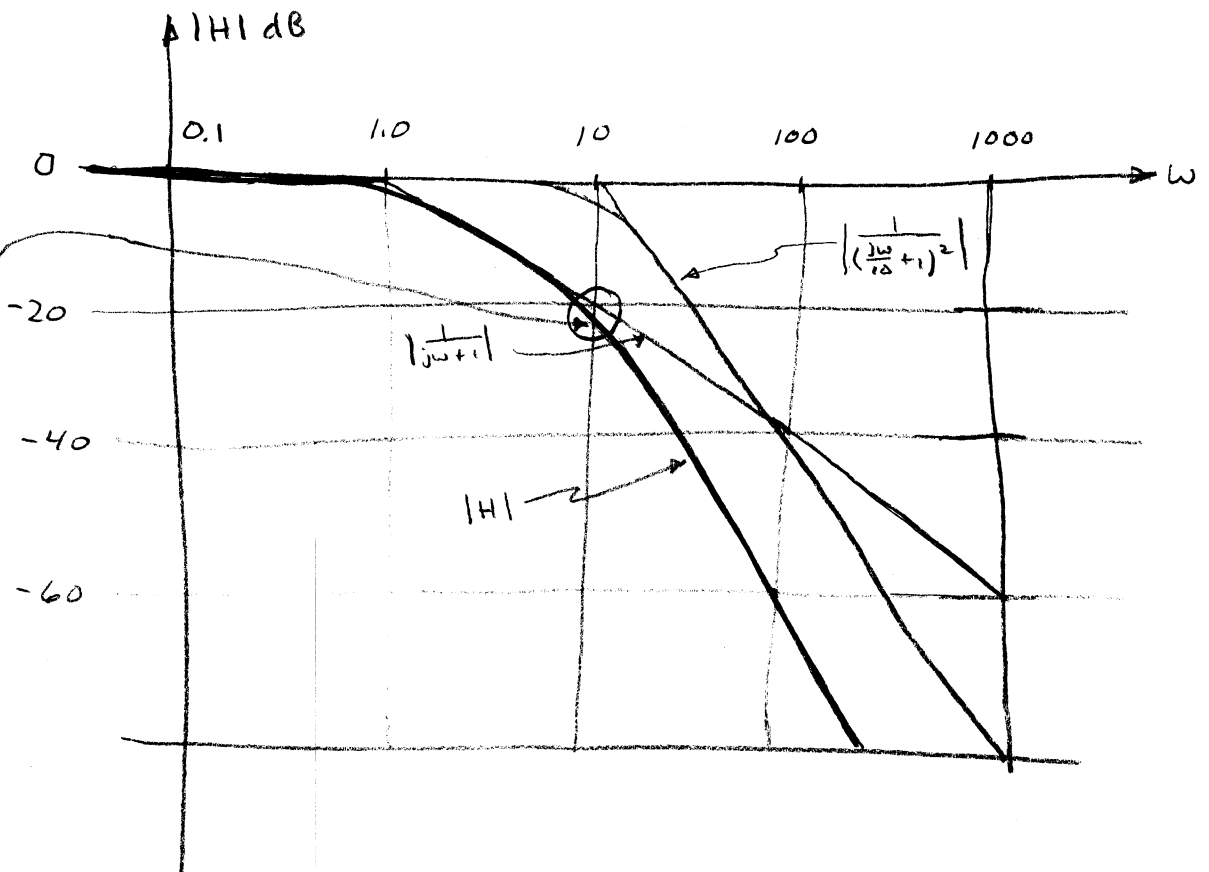
$$= \frac{k}{(\frac{j\omega}{1}+1)(\frac{j\omega}{10}+1)^2}$$

ω	$ H $	$\angle H$
0	k	0
∞	0	$-\frac{3}{2}\pi$ $= -270^\circ$



S 19)

Bode Diagram for $k=1$



Angle passes through -180° at $\omega \approx 12$. Magnitude is approximately -25 dB at $\omega=10$. Need $k = +25$ dB ≈ 18