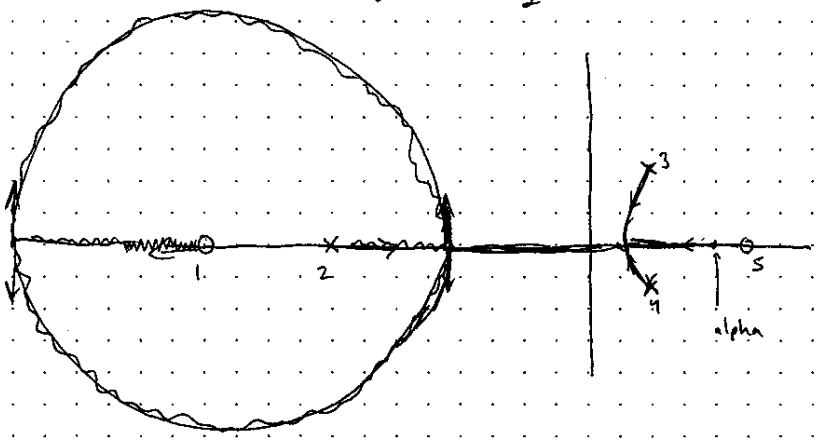
Problem 2:

#1) zeros: $-12, 5$

poles: $-8, \quad \frac{4 \pm \sqrt{16-40}}{2} = \frac{4 \pm 2i\sqrt{6}}{2} = 2 \pm i\sqrt{6}$

$$G(s) = \frac{(s+12)(s-5)}{(s+8)(s^2-4s+10)}$$



$$\alpha = \frac{-4+7}{3-2} = 3$$

$$\phi_\alpha = \frac{180 + 360 \cdot 0}{1} = 180$$

$\psi_1 = (180 + 9.92 + 132 - 9.92 + 180) = 180 + 180$

$= 180 \quad 180$

$\tan^{-1}\left(\frac{\sqrt{6}}{14}\right) = 9.92°$

$\tan^{-1}\left(\frac{\sqrt{6}}{3}\right) = 39.23°$

$\tan^{-1}\left(\frac{\sqrt{6}}{10}\right) \sim 13.76$

$\psi_5 = (0 + -x + x) - 0 + 180 = 180$

$\phi_2 = (0 + 180 + 180 - x) -$

$(0 + 180) - (180 + 180 - x) = 180 = 0$

$\phi_3 = (180 - 39.23° + 9.92°) - (90 + 13.76°) - 180 = -133.07°$

$\phi_4 = +133.07°$

$(s+8)(s^2-4s+10) + K(s+12)(s-5) = 0$

$s^3 + (k+4)s^2 + (7k-22)s - 60k + 80 = 0$

1	$7k-22$
$k+4$	$-60k+80$

$-\left(\frac{-7k^2-66k+108}{k+4}\right)$

$+(-60k+80)$

$k+4=0 \Rightarrow k=-4$

$60k-80=0 \rightarrow k = 4/3$

$7k^2-66k+168=0$

plug into $1 + K \cdot G(s) = 0$

no value of pure imaginary s!!

never touch jw axis