$$\frac{1}{4s^3+2s^2+8s} = \frac{1}{s(4s^2+2s+8)}$$

$$s = \frac{-2 \pm \sqrt{4-4\times4\times8}}{8}$$

$$= \frac{-1}{8} \pm \frac{\sqrt{-124}}{16}$$

$$= \frac{-1}{4} \pm \frac{i\sqrt{31}}{4} = \frac{-1}{4} \pm 1.39j$$

$$\frac{1}{s\left(s+\frac{1}{4}+j\frac{\sqrt{31}}{4}\right)\left(s+\frac{1}{4}-j\frac{\sqrt{31}}{4}\right)}$$

$P = 3 \quad Z = 0$

$P - Z = 3$

$$\sigma_a = \frac{0 + \frac{-1}{4} + j\frac{\sqrt{31}}{4} + \frac{-1}{4} - j\frac{\sqrt{31}}{4}}{3}$$

$$= \frac{\frac{-1}{2}}{3}$$

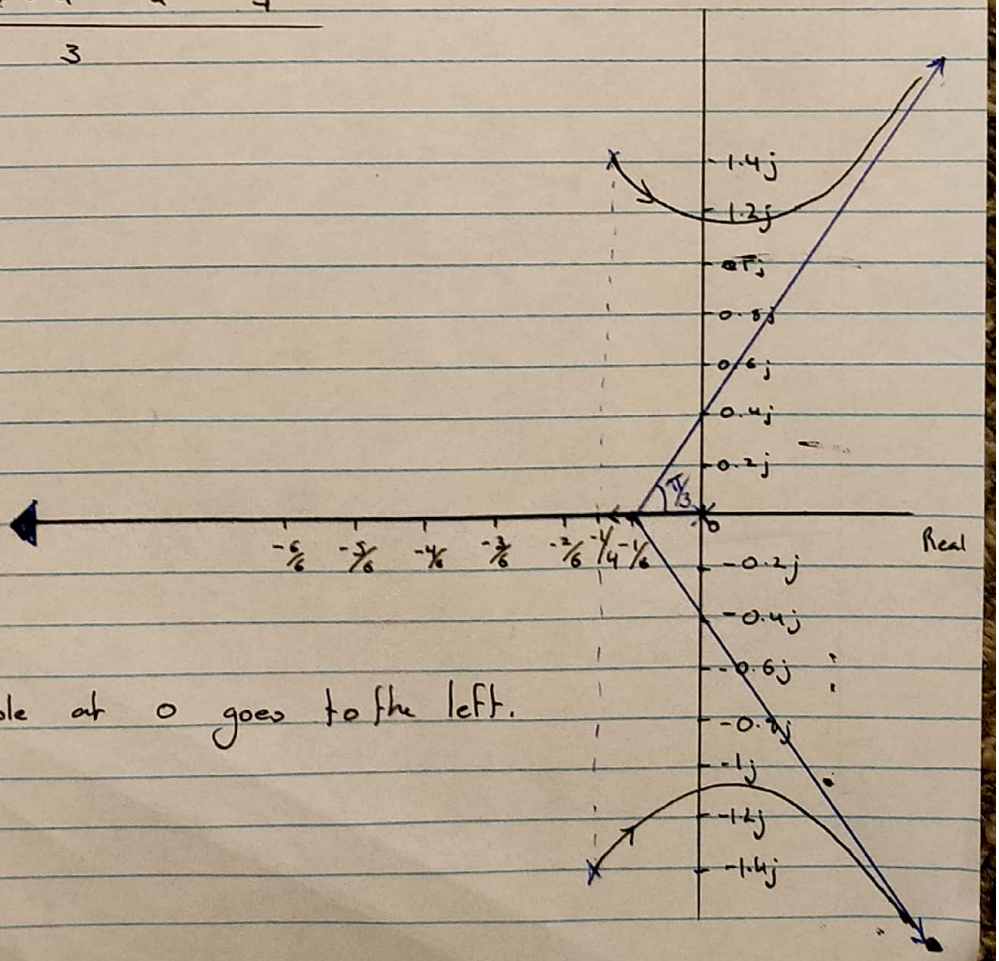
$$= -1/6$$

$$\theta_a = \frac{(2k+1)\pi}{3}$$

$k = 0 \quad \theta_a = \frac{\pi}{3}$

$k = -1 \quad \theta_a = \frac{-\pi}{3}$

$k = 1 \quad \theta_a = \pi$




Pole at 0 goes to the left.

$$\frac{s^2+4s+12}{3s^2+6s+1} = \frac{(s+2+2\sqrt{2}j)(s+2-2\sqrt{2}j)}{(s+1+\frac{\sqrt{6}}{3})(s+1-\frac{\sqrt{6}}{3})}$$

top $s = \frac{-4 \pm \sqrt{16-48}}{2}$

$= \frac{-4 \pm 4\sqrt{2}j}{2}$

$= -2 \pm 2\sqrt{2}j = -2 \pm 2.828j$

Bottom $s = \frac{-6 \pm \sqrt{36-12}}{6}$

$= \frac{-6 \pm \sqrt{24}}{6}$

$= -1 \pm \frac{1}{3}\sqrt{6}$ $= -1.82$ or $= -0.1835$.

$P = 2$ $Z = 2$. no asymptotes.

$$k = -\left(\frac{3s^2+6s+1}{s^2+4s+12}\right) \qquad s = \sigma$$

$$= \frac{-3s^2-6s-1}{s^2+4s+12}$$

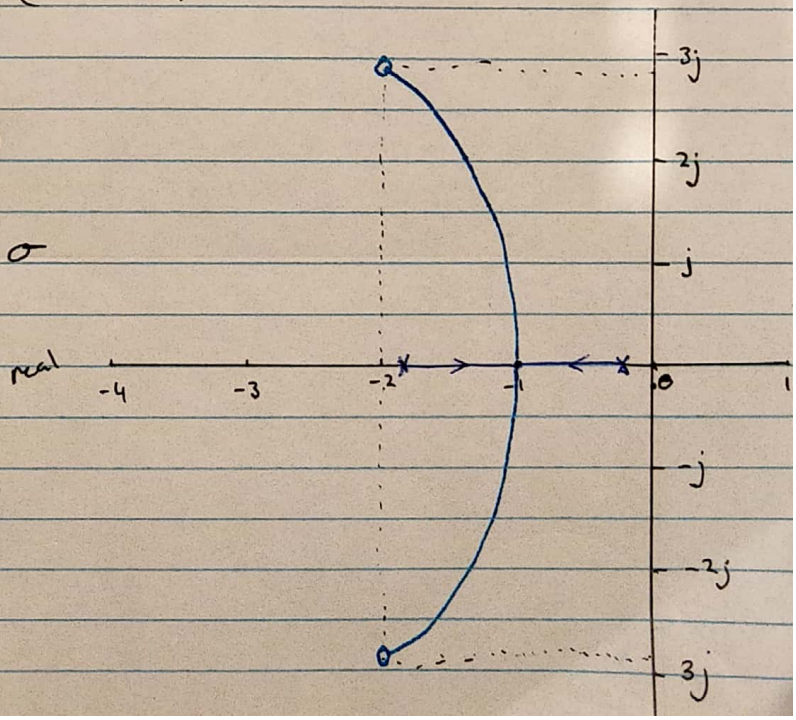
$$\frac{dk}{d\sigma} = \frac{(-6s-6)(s^2+4s+12)-(2s+4)(-3s^2-6s-1)}{(s^2+4s+12)^2}$$

$$= \frac{-6s^3-24s^2-72s-6s^2-6-24s-72+(6s^3+12s^2+12s^2+24s+4)}{(s^2+4s+12)^2}$$

$$= \frac{-6s^2-70s-68}{(s^2+4s+12)^2}$$

$$= \frac{(s+1.067)(s+10.6)}{(s^2+4s+12)^2}$$

Break off at $-1.069 = \sigma$



$$\frac{1}{s^4+4s^3+6s^2+6s+1} = \frac{1}{(s+0.202)(s+2.494)(s+0.652-1.25j)(s+0.652+1.25j)}$$

$P=4 \quad Z=0 \quad P-Z=4$

$$\sigma_a = \frac{-0.202-2.494-0.652-0.652}{4}$$

$$= -1$$

$$\theta_a = \frac{(2k+1)\pi}{4}$$

$k=0 \quad = \frac{\pi}{4}$

$k=1 \quad = \frac{3\pi}{4}$

$k=-1 \quad = -\frac{\pi}{4}$

$k=-2 \quad = -\frac{3}{4}\pi$

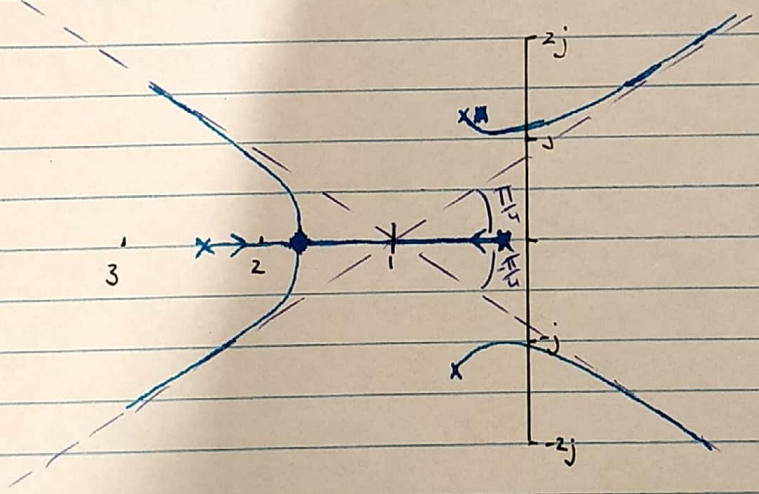
Break off points.

$$k = -s^4-4s^3-6s^2-6s-1$$

$$\frac{dk}{ds} = -4s^3-12s^2-12s-6$$

$$= (s+1.793)\left(s-1-\frac{1-j\sqrt{3}}{2\sqrt[3]{2}}\right)\left(\text{conjugate}\right)$$

Break off at $\sigma = -1.793$.



$$\frac{2s+4}{5s^3+6s^2+s} = \frac{2(s+2)}{s(5s^2+6s+1)}$$

$$= \frac{2(s+2)}{s(s+0.2)(s+1)}$$

$P=3 \quad Z=1$

$P-Z=2$

$$\sigma_a = \frac{0-0.2-1-(-2)}{2}$$

$$= \frac{0.8}{2}$$

$$= 0.4$$

$$\theta = \frac{(2k+1)\pi}{2}$$

$$= \frac{\pi}{2} \quad \text{for } k=0$$

$$= -\frac{\pi}{2} \quad \text{for } k=-1$$

Break off point

$$k = \frac{-5s^3-6s^2-s}{2s+4}$$

$$\frac{dk}{ds} = \frac{(-15s^2-12s-1)(2s+4)-(-5s^3-6s^2-s)(2)}{(2s+4)^2}$$

$$= \frac{-30s^3-\overset{12}{\cancel{24}}s^2-\cancel{2s}-60s^2-48s-\cancel{4}+10s^3+\cancel{12}s^2+\cancel{2}s}{(2s+4)^2}$$

$$= \frac{-\overset{2}{\cancel{3}}0s^3-72s^2-48s-4}{(2s+4)^2}$$

$$= -4\left(\frac{5s^3+18s^2+12s+1}{(2s+4)^2}\right)$$

top $= 0$

$5s^3+18s^2+12s+1=0$ — Break off point with Branches through it

$(s+2.7553)(s+0.74761)(s+0.097092)=0$