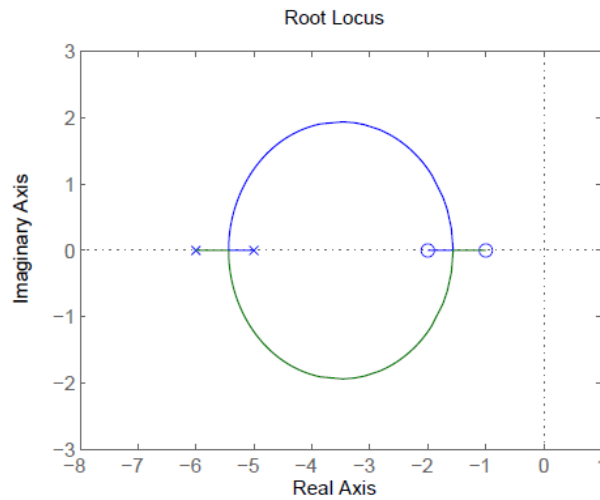Draw root locus and find the break-in and break away points for the system given below

$$G(s) = \frac{K(s + 1)(s + 2)}{(s + 5)(s + 6)}$$

Root Locus

To find the break–in and breakaway points, we apply rule 6 as follows:

$$K(\sigma) = -\frac{(\sigma + 5)(\sigma + 6)}{(\sigma + 1)(\sigma + 2)} = -\frac{\sigma^2 + 11\sigma + 30}{\sigma^2 + 3\sigma + 2}.$$

Taking the derivative,

$$\frac{dK}{d\sigma} = -\frac{-8\sigma^2 - 56\sigma - 68}{(\sigma^2 + 3\sigma + 2)^2} = -4\frac{-2\sigma^2 - 14\sigma - 17}{(\sigma^2 + 3\sigma + 2)^2}.$$

and setting $dK/d\sigma = 0$, we find $\sigma_1 = -1.5635$ and $\sigma_2 = -5.4365$.