Q7 KEY

$$GH = \frac{s-5}{(s^2+10s+26)(s+1)}$$

OL poles at $s=-1$, $s=-5\pm j$

OL zeros at $s=5$

Rule

1. There are 3 branches
2. The locus is symmetric
3. The locus begins at $(-1, -5-j, -5+j)$ and ends at 5 and 2 infinite zeros
4. The locus is on the axis between -1 & 5.
5. Asymptotes are described by

$$\sigma_0 = \frac{(-1-5+j-5-j)-5}{3-1} = -8 \qquad \theta = \pm\frac{180}{2} = 90°, 270°$$

6. No Departure or arrival pts
7. $$\frac{G}{1+GH} = \frac{K(s-5)}{s^3+11s^2+(36+K)s+(26-5K)}$$

Routh Table

s^3	1	$36+K$
s^2	11	$26-5K$
s^1	$\frac{16K+370}{11}$	$\longrightarrow K = -23.125$
s^0	$26-5K$	$\longrightarrow K = 5.2$

Plug 5.2 in to denominator

$$s^3+11s^2+41.2s = 0 \quad \text{at} \quad s=0,\ s=-5.5\pm j3.31$$

8 from $s=-5+j$

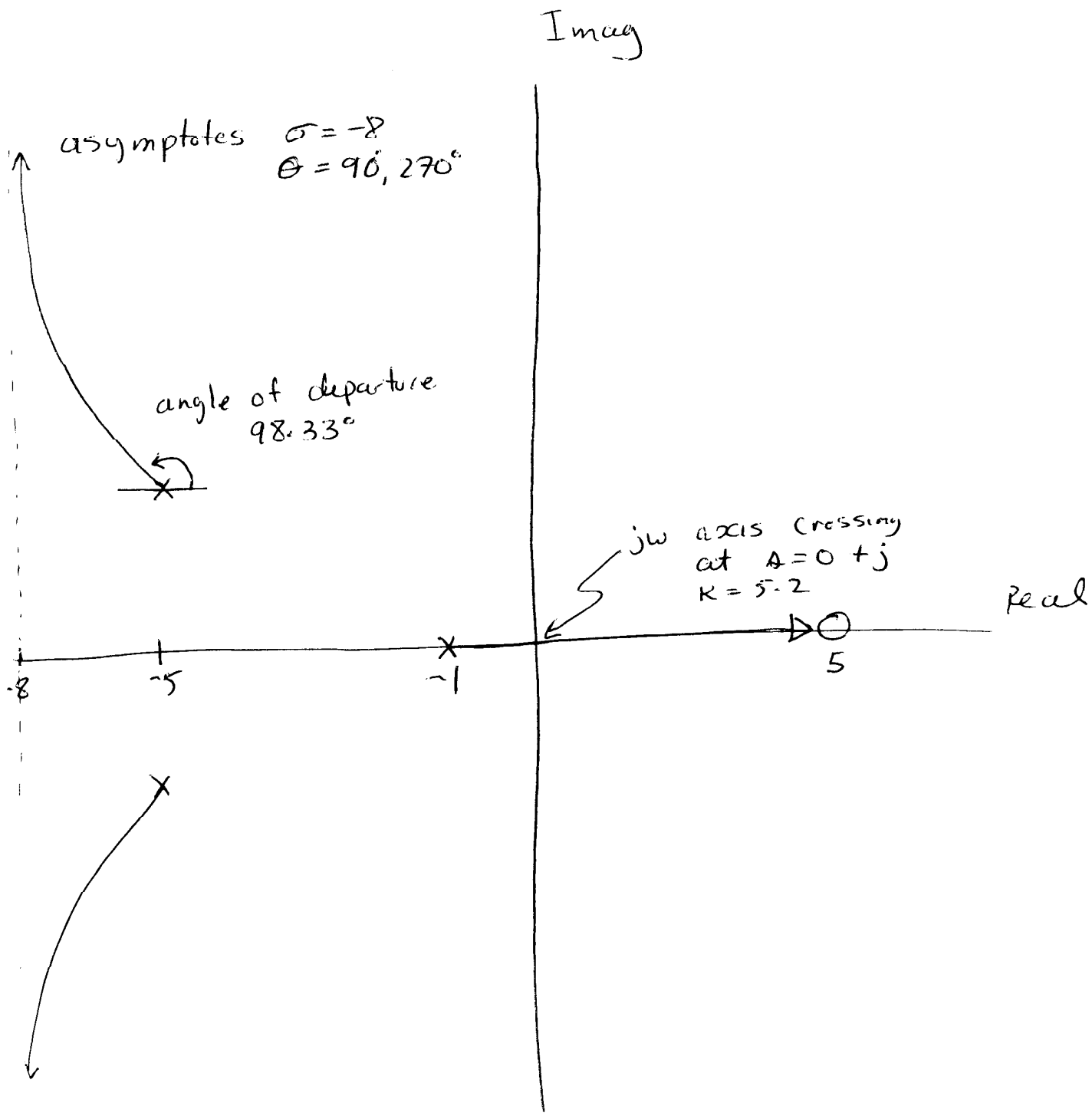
angle from -1: 165.96
angle from $-5-j$: 90°
angle from 5: 174.29

$$\theta = 180-(165.96-90)+174.29 = 98.33°$$

By symmetry, $s=-5-j$ has $\theta = 261.67$

$s=-1$ has $\theta = 0°$ $\quad s=5$ has $\theta = 180°$

Q7 KEY Cont'd


Imag
asymptotes σ = -8
θ = 90°, 270°
angle of departure
98.33°
jω axis crossing
at Δ = 0 + j
K = 5.2
Real
-8
-5
-1
5