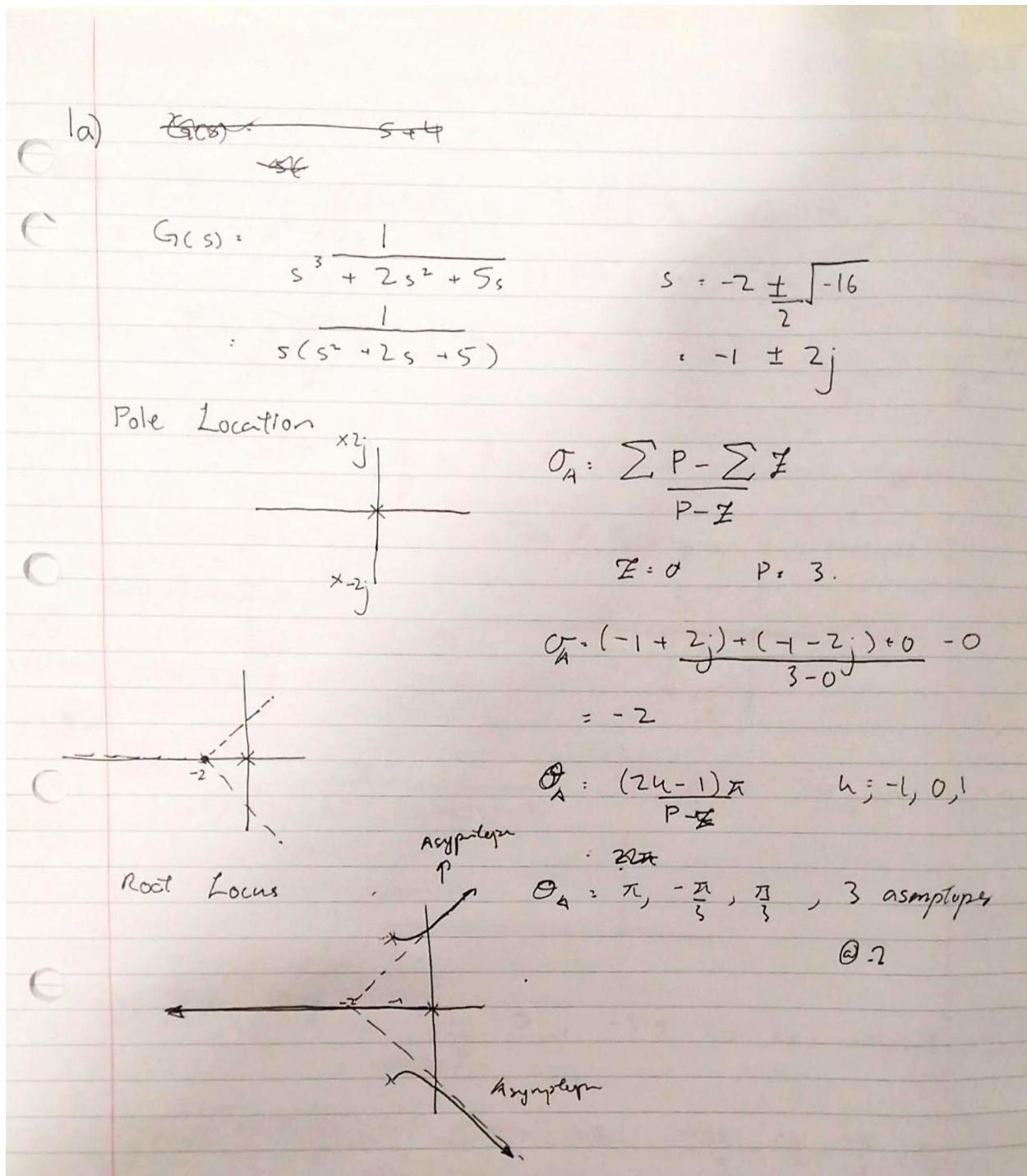


Question 1

1a)



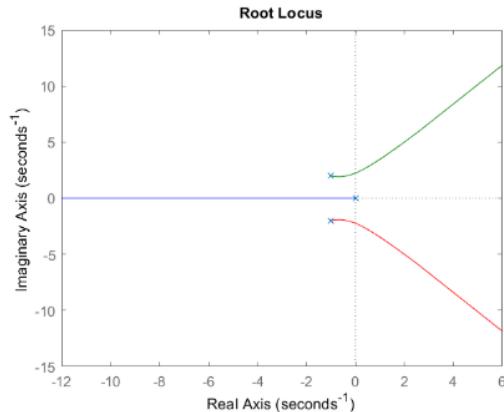
edit: i noticed the centroid of asymptote is slightly miscalculated; it's meant to be  $-\frac{2\pi}{3}$  as opposed to  $-2$ . No real axis intercept as it doesn't touch the real axis.

```

sys =
1
-----
s^3 + 2 s^2 + 5 s

Continuous-time transfer function.

```



1b)

$$b) G(s) = \frac{s^2 + 4s + 8}{s^2 + 5s + 4}, \quad -2 \pm \sqrt{\frac{16}{4}} \quad \text{for } \sigma s = -2 \pm 2i \\ (s+4)(s+1) \quad \text{for pole.}$$

$$\sum P - \sum Z = (-4 + -1) - (-2 \pm 2i) = -5 - -4 = \frac{-1}{0}$$

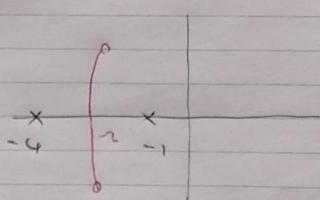
$$\theta = (2n-1)\pi = 0 \quad \text{as } P-Z=0 \quad 2 \text{ poles } 2 \text{ zeros}$$

$$\sum \frac{1}{\sigma - Z} = \sum \frac{1}{\sigma - P}$$

$$\frac{1}{\sigma - (-2+2j)} + \frac{1}{\sigma - (-2-2j)} = \frac{1}{s+4} + \frac{1}{s+1}$$

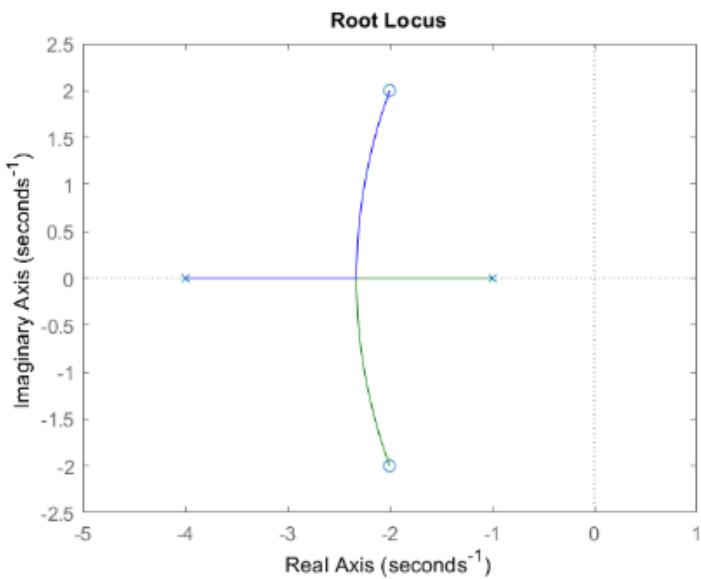
$$= \frac{1}{s^2 + 5s + 4} = (-s^2 - 8s - 24)$$

$$= s^2 - 8s - 24 = \sigma_1 = 10.324 \\ \sigma_2 = -2.324$$



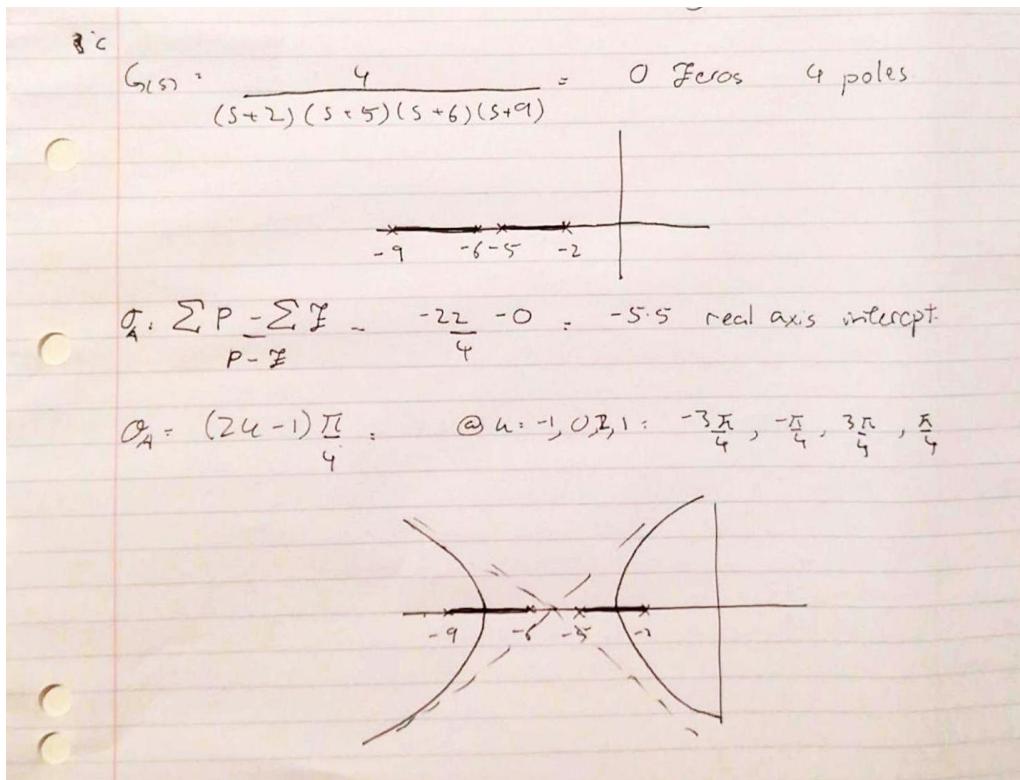
$$\frac{s^2 + 4s + 8}{s^2 + 5s + 4}$$

Continuous-time transfer function.



Not exactly spot on but looks very similar

1c)



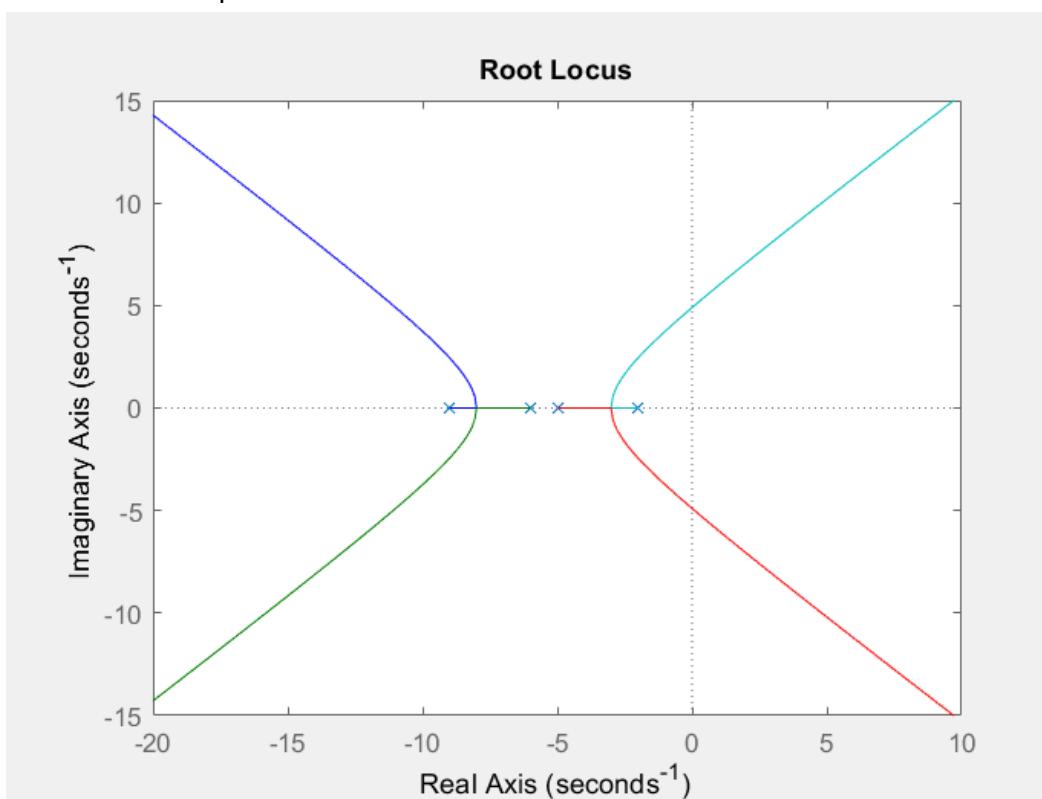
-5.5 is not the real axis intercept. It's the centroid.

$$1c \quad \sum \frac{1}{s-p} \leftarrow \sum \frac{1}{s-p}$$

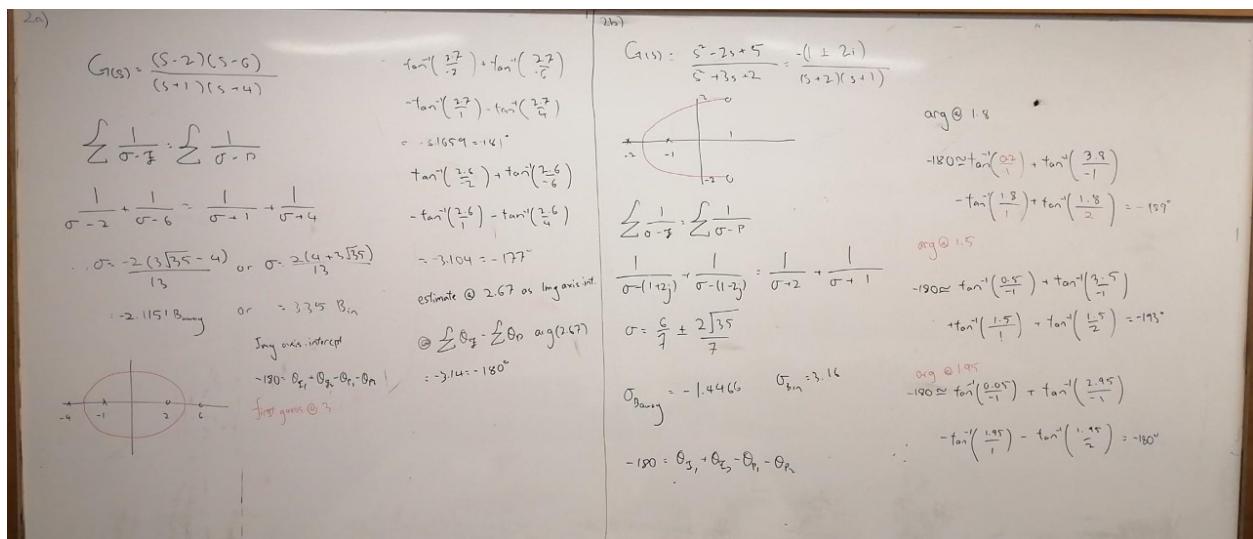
$$G(s) = \frac{1}{s+2} + \frac{1}{s+5} + \frac{1}{s+6} + \frac{1}{s+9}$$

$$\sigma = -7.9, -5.4, -2.7803, 1.4953$$

Real axis intercept is -7.9 and -2.7 since -5.4 is not between the connection of the poles.



## Question 2

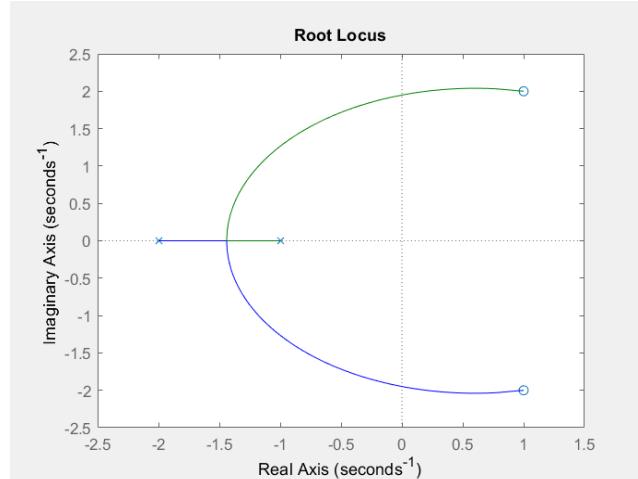
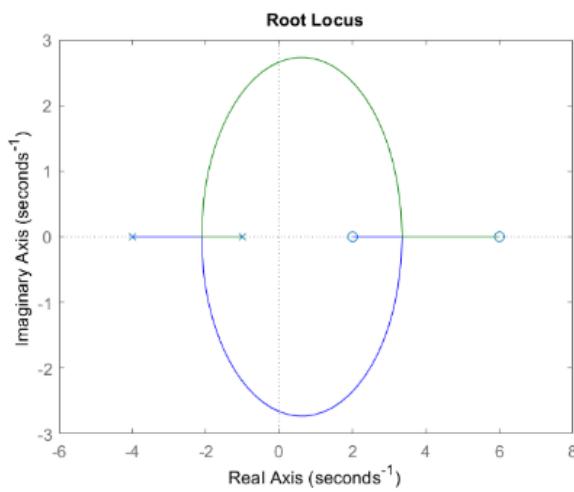


It doesn't go into 3.16 on the real axis as it's canceled by the zeros.

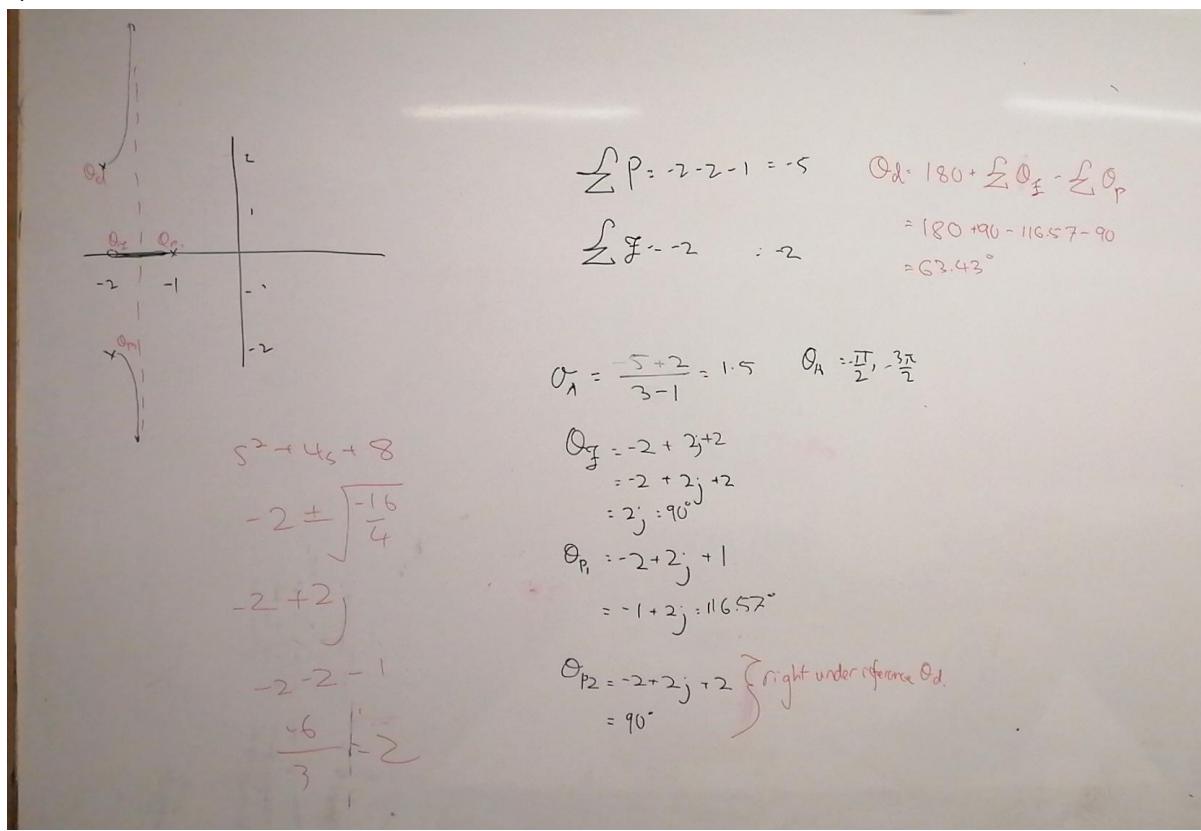
## Verification via matlab

```
s^2 + 8 s + 12
-----
s^2 + 5 s + 4
```

Continuous-time transfer function.



3)



Angle of departure is 63.43 degrees