ECE 141 Homework 2

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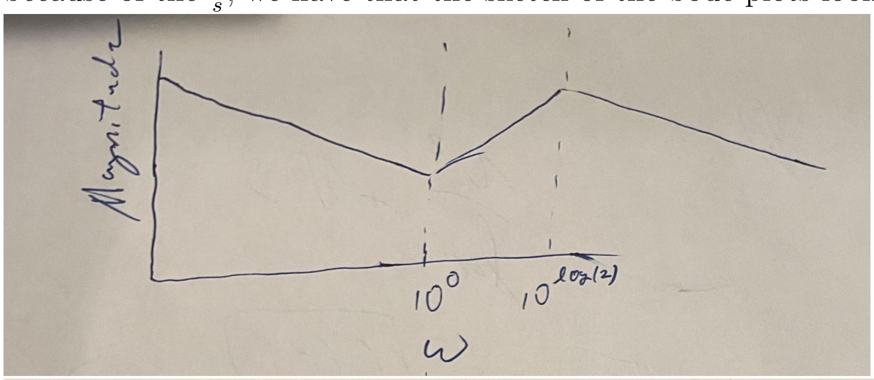
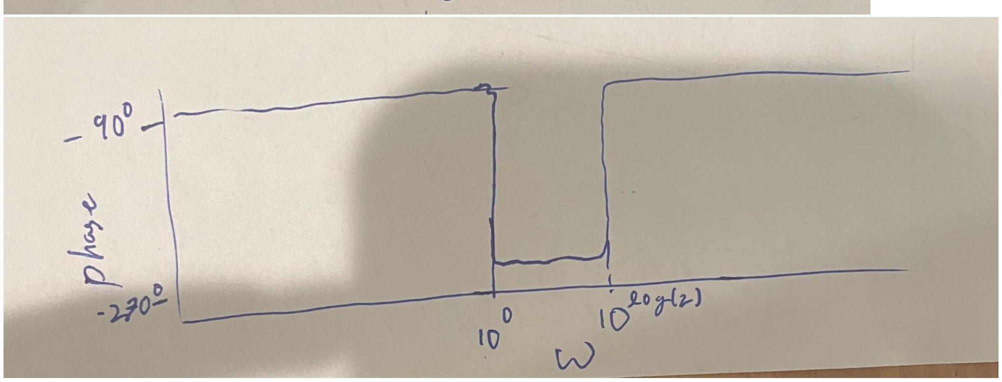
Problem 6.5

This has two break points, one at $\omega = 1$ and another at $\omega = 2$. Furthermore because of the $\frac{1}{s}$, we have that the sketch of the bode plots look like.

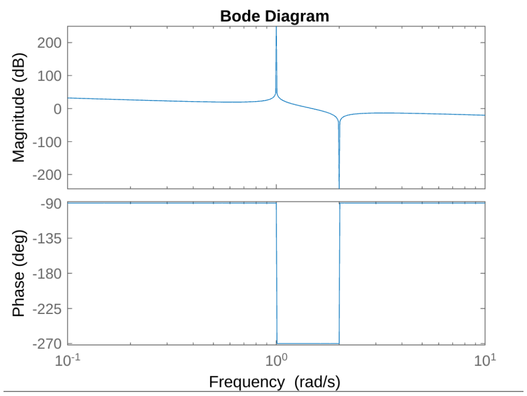




We can confirm this with the following matlab code

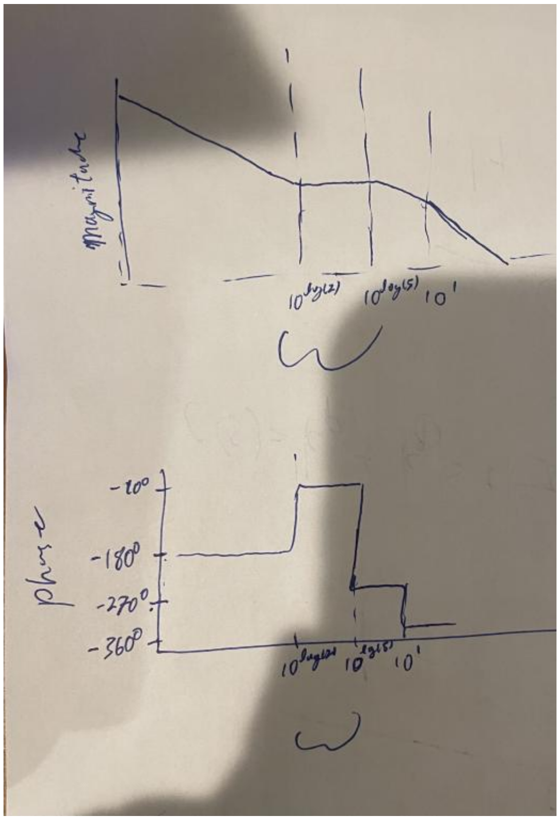
```
sys = tf([1 0 4], [1 0 1 0]);
bode(sys)
```

Which outputs the following plot



Problem 6.7

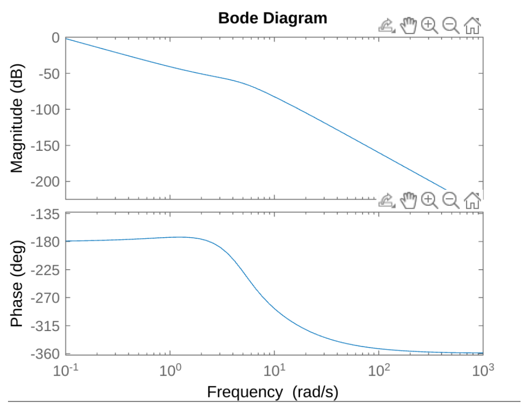
There are 3 break points, one first order one at $\omega = 2$ in the numerator, one second order one at $\omega = 5$ in the denominator and a first order one at $\omega = 10$ in the denominator. Furthermore since there also exists a s^2 in the denominator, we start of initially with a slope of -2. Therefore, we can the sketch of the bode plot looks like.



We can confirm this with the following matlab code

```
u = [1 10];
v = [1 0 0];
y=[1 6 25];

conv(conv(u,v),y)

sys = tf([1 2], conv(conv(u,v),y));
bode(sys)
```

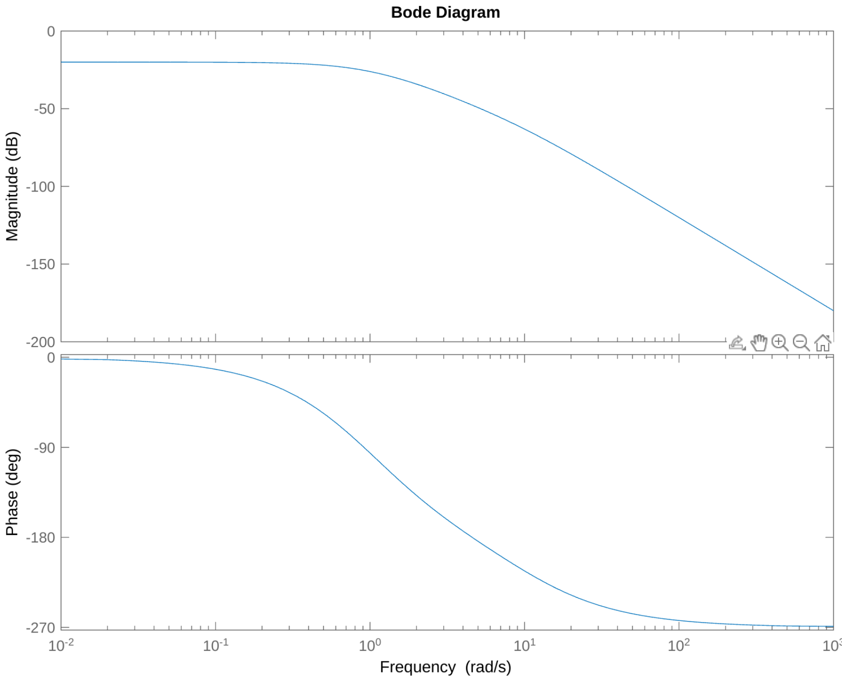
Which outputs the following plot



Problem 6.16

through this matlab code we get the following bode plot

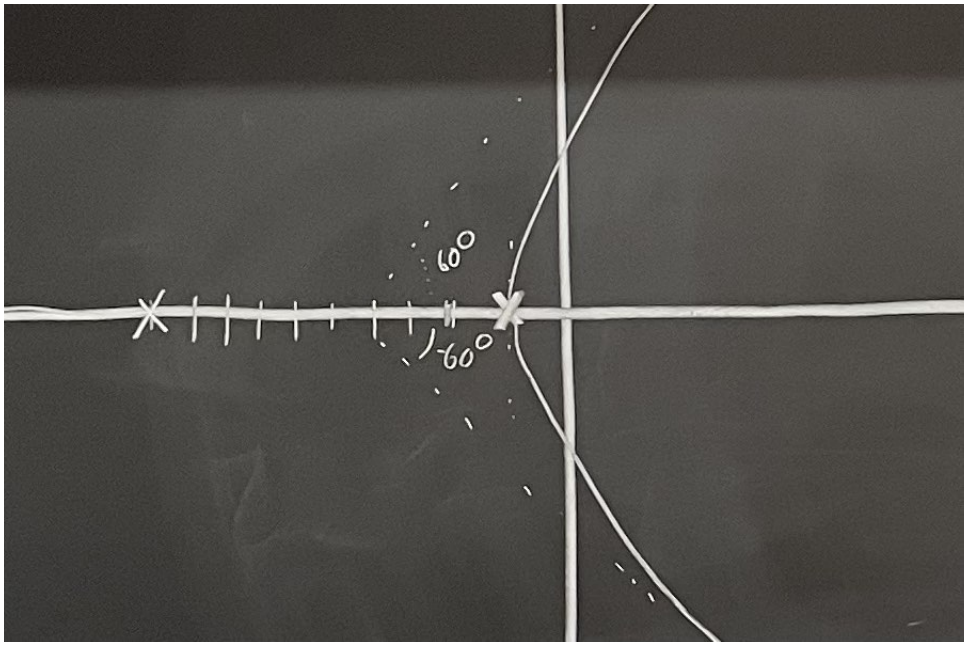
```
u = [1 10];
v = [1 1];


conv(conv(u,v),v)

sys = tf([1], conv(conv(u,v),v));
[mag,phase,wout] = bode(sys)
```



Therefore, with the following matlab code we find that $K < 251.5348$ for stability

```
m=mag(phase<-180);
1/max(m)
```

We can confirm this by plotting out the root locus, we have that there are 3 poles, 2 at -1, and 1 at -10, with angles of departure of $\pm 90^{circ}$ and $180°$. $\alpha = 4$, the assympotic angles are $\pm 60°$ and $180°$. Therefore the root locus looks like

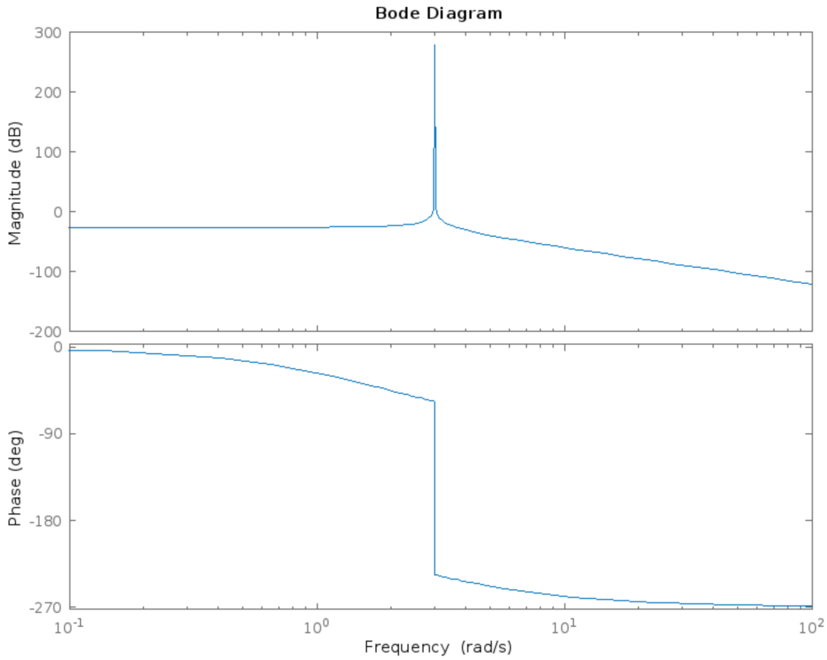


Problem 6.17

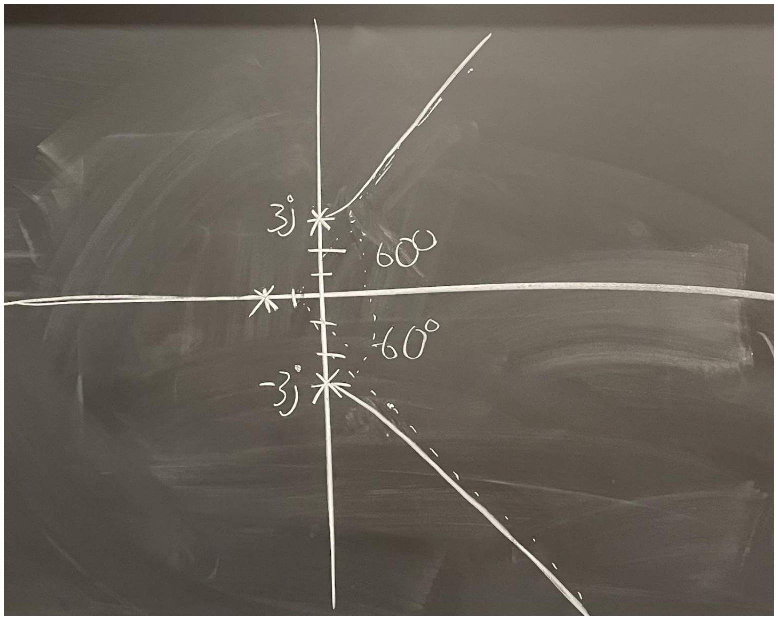
Plotting out the bode plot with the following code

```
u = [1 0 9];
v = [1 2];


conv(u,v)

sys = tf([1], conv(u,v));
bode(sys)
```

which yields the following bode plot



There is a spike at $\omega = 3$, therefore there is a spike to infity at that point, furthermore, the phase will change by -180° at that point. Therefore no values of K can make the system stable, we can confirm this by plotting out the root locus, we have that there are 3 poles, 2 at $\pm 3j$ and one at -2, the angles of departure from these poles are $\pm 33.69^\circ$ and 180° respectively, furthermore $\alpha = \frac{2}{3}$, the assympotic angles are $\pm 60^\circ$ and 180°. Therefore the root locus looks like


3j
60°
-60°
-3j