Q1

Freq	Step	Reason
A	D	Replicated with $\frac{s}{s^2+s+1}$
B	C	$mag(s \to 0) = Amp(t \to \infty) = 1$ & A is taken
C	A	Replicated with $\frac{1}{s^2+s+1}$
D	B	$mag(s \to 0) = Amp(t \to \infty) = 0$ & D is taken

Q2.

1. Pros:

- Amplify V_i linearly, precise
- Can use offset to negate deadzone & cross over distortion
- use as amplifier
  - → ex: audio amp

Cons:

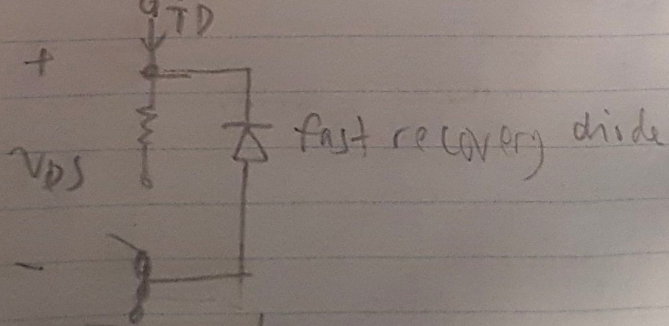
- may have dead zone, area where increase V_i doesn't increase V_o
- Cross over distortion if V_i is AC
- high power dissipation for controls application
  - larger device size
  - need cooling components

2. Pros:

- Can combine switches in circuit for different logic
  - half bridge
  - half bridge inverter
- use as DC/DC down converter
- use as switch
  - → ex: on/off power source

Cons:

- Shoot through if user is clumsy with high bridge
- Current ripple cause
  - torque ripple, system vibrate
  - losses like hysteresis, eddy current
  - use series inductor to negate

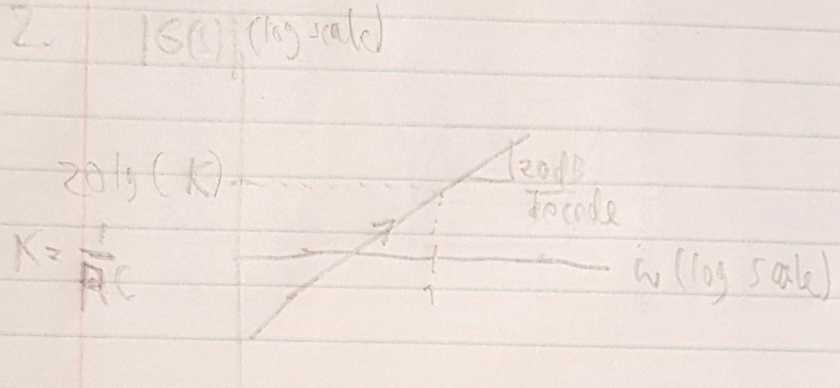
3. 

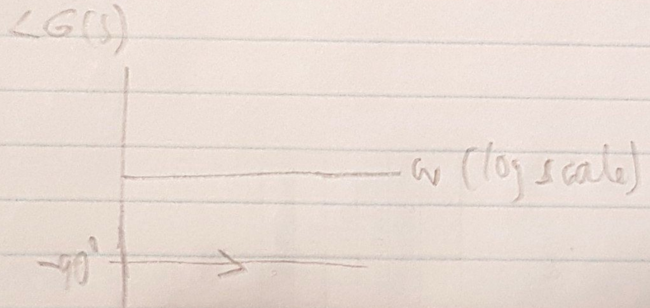
4. Shoot Through:
Create current flow path between V_{DC} & GND
Short circuit
May burn components

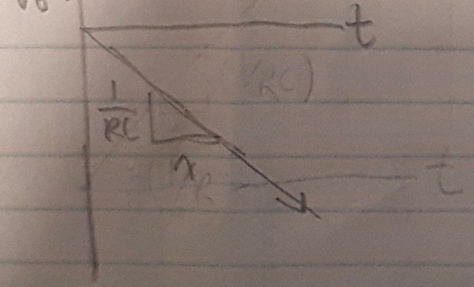
Q3
Part 1

$$0 = \frac{V_0}{R} + \frac{dV_i}{dt} C$$

1. $G(s) = \frac{V_0}{V_i} = \frac{-1}{RCs} =$

2. 



3. 

4. $V_i(s) = \frac{s}{s^2 + w^2}$

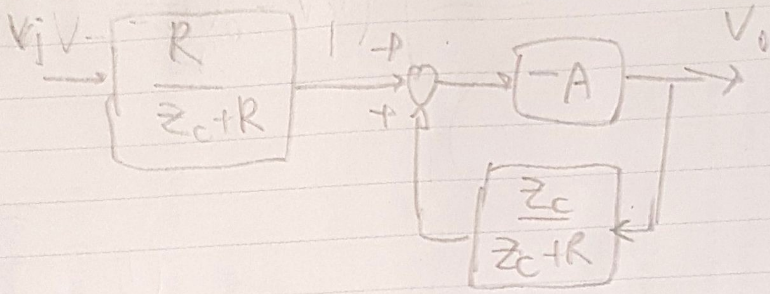
$$V_o(s) = G(s)\,V_i(s) = \left(\frac{1}{RC}\right)\frac{(-1)}{(s^2+w^2)} = \left(\frac{-1}{wRC}\right)\left(\frac{w}{s^2+w^2}\right)$$

$$V_o(t) = \left(\frac{-1}{wRC}\right)\sin(wt)$$

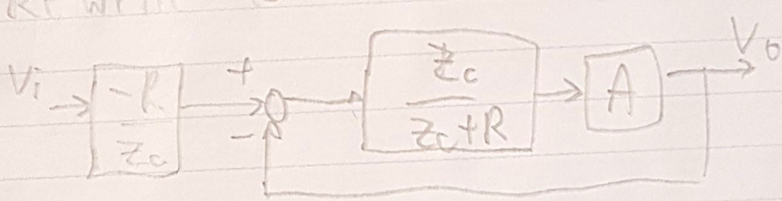
Q3
pt 2

5. $Z_c = \frac{1}{sC}$

$Z_R = R$



Rewrite as



6. $L(s) = A\frac{Z_c}{Z_c+R} = A\left(\frac{1/sC}{\frac{1}{sC}+\frac{sCR}{sC}}\right) = \frac{A}{1+sCR}$

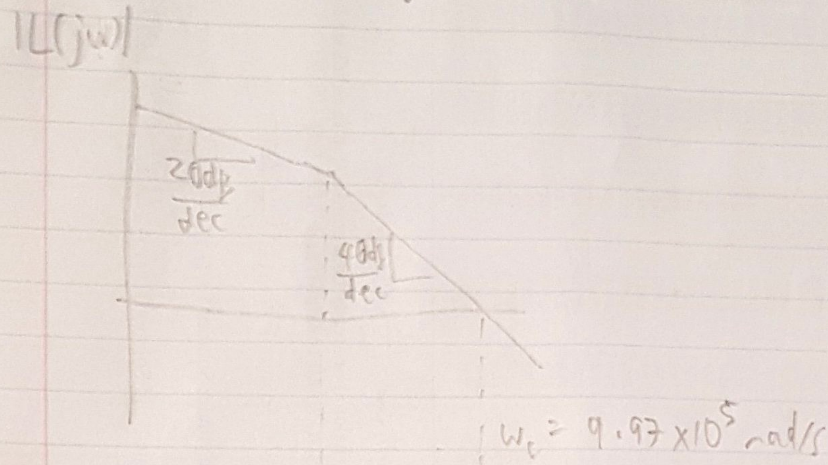
$T(s) = \frac{L(s)}{1+L(s)} = \frac{A}{A+1+sCR}$

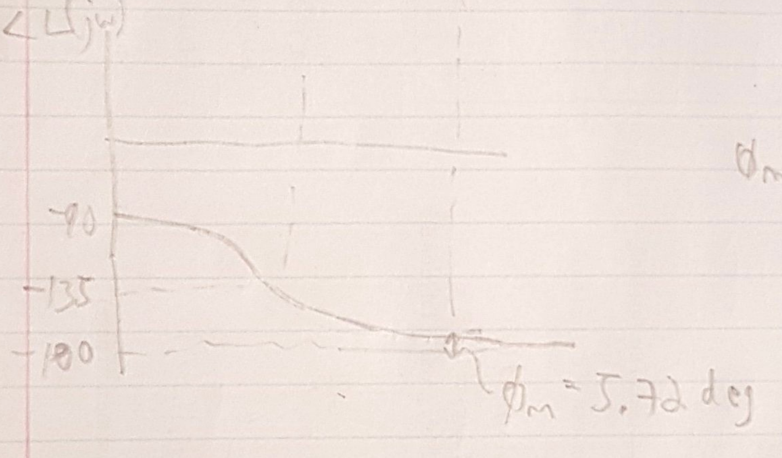
7. $G(s) = \frac{-R}{Z_c}\left(\frac{L}{1+L}\right)$

$= \frac{-R}{Z_c}L\left(\frac{1}{1+L}\right)$

$= \left(\frac{-R}{Z_c}\right)L(s)\,T(s)$

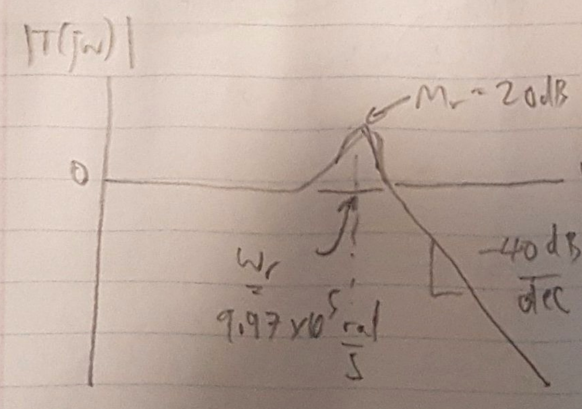
8. $L = \dfrac{\frac{10^7}{s}}{1 + s(9\times10^{3})(.01\times10^{-6})} = \dfrac{10^7}{10^{-5}s^2 + s} = \left(\dfrac{10^7}{s}\right)\left(\dfrac{1}{10^{-5}s+1}\right)$

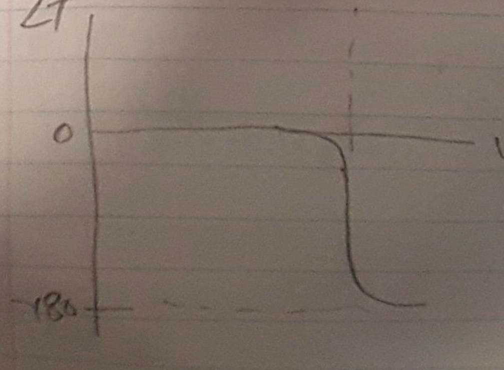




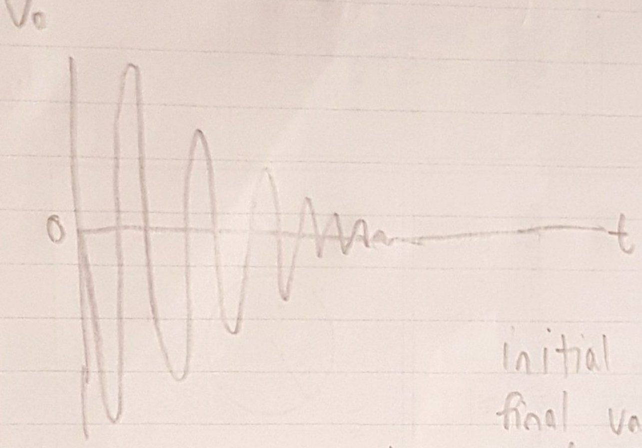
$\phi_m = \angle L(j\omega_c) + 180°$

9. $T(s) = \dfrac{L}{1+L(s)} = \dfrac{100s^2 + 10^7 s}{10^{-10}s^4 + 2\times10^{-5}s^3 + 101s^2 + 10^7 s}$





10. $G(s) = \frac{L}{1+L}\left(\frac{-10^3}{(1/s10^{-8})}\right) = \frac{-.001s^3 - 100s^2}{10^{-10}s^4 + 2\times10^{-5}s^3 + 101s^2 + 10^7 s}$



initial value = 0
final value = 0
ω = period of oscillation $\approx 6.29\times10^{-6}$ s

x	y
4.71×10^{-6}	7.91
1.1×10^{-5}	5.78
1.73×10^{-5}	4.22

Curve fitting

$V_o = (-.02013 + 10.023e^{-49728t})(-\sin\omega t)$

exponential decay part

oscillation part