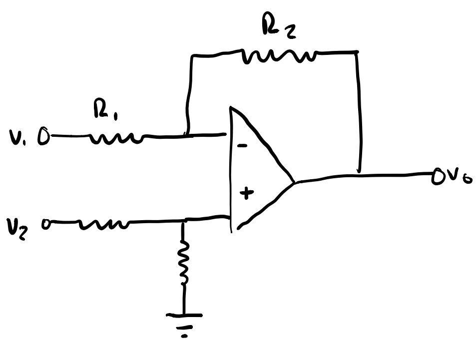
Nolan Anderson

a)



$G = 25\,v/v$

$R_{id} = 2R_1 = 100k\Omega$

$R_1 = 50k\Omega$

$A_d = 25 = \frac{R_2}{R_1} \Rightarrow \quad R_2 = 50 \times 25 = 1.25m\Omega$

For $A_{cm} = 0 \ldots \quad R_4 = R_2 = 1.25m\Omega$

$R_1 = R_3 = 50k\Omega$

$A_{cm} = -\frac{R_2}{R_1} + \left(1 + \frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3 + R_4}\right) \quad \boxed{A_{cm} = 0}$

$\frac{1.25E6}{50E3} + \left(1 + \frac{1.25E6}{50E3}\right)\left(\frac{1.25}{50 + 1.25}\right)$

b

$R_4 = 1.375m\Omega \qquad R_2 = 1.125m\Omega$

$R_3 = 50k\Omega \qquad R_1 = 50k\Omega$

$$Ad = \frac{1}{2}\left(\frac{R_2}{R_1} + \left(1 + \frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3 + R_4}\right)\right)$$

$$\frac{1}{2}\left(\frac{1.125E6}{50E3} + \left(1 + \frac{1.125E6}{50E3}\right)\left(\frac{1.375E6}{50E3 + 1.375E6}\right)\right)$$

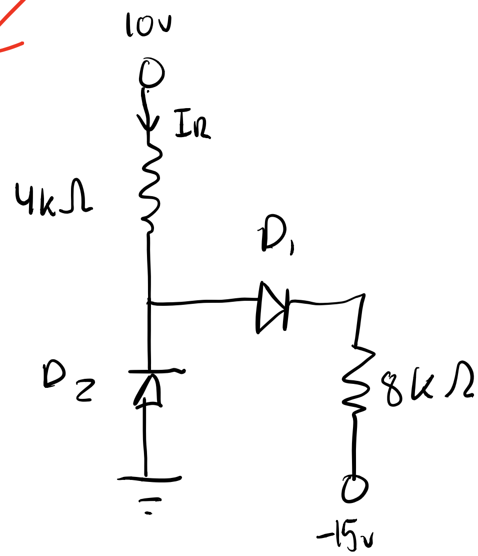
$$Ad = 22.587 \ V/V$$

$$ACm = -\frac{R_2}{R_1} + \left(1 + \frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3 + R_4}\right) \quad \boxed{ACm = 0}$$

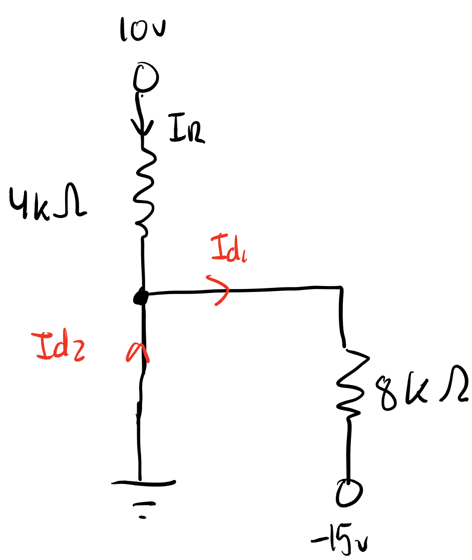
$$-\frac{1.125E6}{50E3} + \left(1 + \frac{1.125E6}{50E3}\right)\left(\frac{1.375E6}{50E3 + 1.375E6}\right)$$

$$ACM = .175 \ V/V$$

2



Both on:

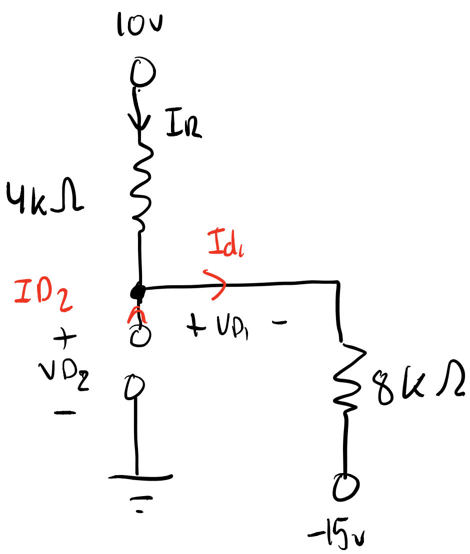


$Id1$ & $ID_2 > 0$

$$ID_1 = \frac{0-(-15v)}{8} = \frac{15}{8} = 1.875$$

$$ID_2 = \frac{0-10v}{4} = -.4$$

I_{D_2} off / I_{D_1} on



$I_{D_2} = 0$

$I_{D_1} = 1.875 A$

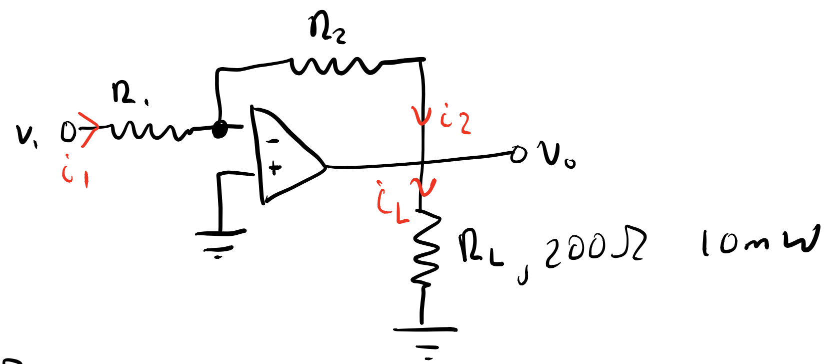
$V_{D_1} = I_{D_1}(8) \Rightarrow V_{D_1} = 15v$

$\boxed{V_{D_1} = 15\,v}$

$\boxed{V_{D_2} = 0(4k\Omega) = 0v}$

$\boxed{I_R = \frac{-10+15}{4+8} \Rightarrow I_R = 0.416 A}$

3)



$G = 18\,dB$

$I_R = 400k\Omega$

$\frac{V_o^2}{200\Omega} = 10mW \quad V_o^2 = 2$

$\boxed{V_o = 1.41V}$

$G = 18 = 7.94\,V/V = \frac{V_o}{V_S} = 7.94 = \frac{1.41}{V_S}$

$\boxed{V_I = .1776\ V}$

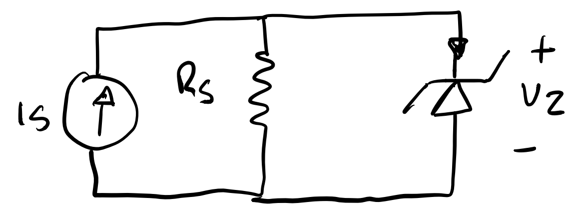
$i_L = \frac{V_o}{R_L} = \frac{1.41}{200} = .00705A$

$i_2 = \frac{0 - V_o}{R_2} = R_2 = \frac{1.41}{.00705}, \boxed{R_2 = 200\Omega}$

$G = \frac{V_o}{V_S} \quad \frac{V_o}{V_I} = -\frac{R_2}{R_1} = 7.94 \quad -\frac{200}{R_1} = 7.94$

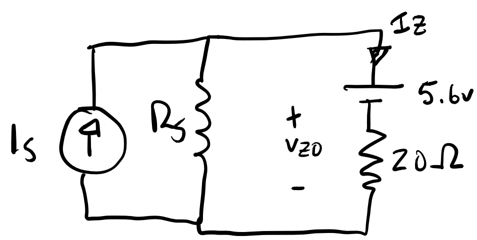
$7.94\,R_1 = 200 = \boxed{R_1 = 25.19\Omega}$

4



$V_Z = 5.6\ V$

$I_Z = 3.25 mA$



$V_{ZO} = V_Z - I_Z R_Z$

$V_{ZO} = 5.6 - (3.25mA)(20\Omega)$

$V_{ZO} = 5.6 - (.00325)(20)$

$\boxed{V_{ZO} = 5.535\ V}$

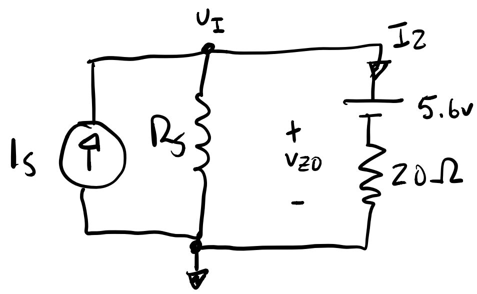
Want $I_Z = 5mA$

$R_S = ?$

$V_{ZO} = 5.535$

$I_S = 12 mA$

$V = IR$



$V_Z = V_{ZO} + I_Z R_Z$

$= 5.535 + (.00325)(20)$

$V_Z = 5.6$

$V_Z = 5.6$

$I_S = 12mA$

$I_Z = 5mA$

$V = IR$

$I = \frac{V}{R}$

$5mA = \frac{5.535}{20 + R_S}$

$.1 + .005 R_S = 5.535$

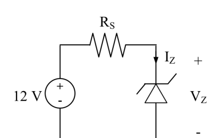
$.005 R_S = 5.435$

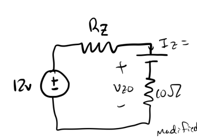
$R_S = 1087\Omega$

$\boxed{R_S = 1.087 k\Omega}$

Print Your Name____

4. [15 points] Consider the following circuit that contains a Zener diode. It is known that when the Zener voltage is 4.7 V, the Zener current is 15mA. The incremental Zener resistance is 10 Ω. Find the value of V_{ZO} and design the resistor, R_S for a Zener current of 20 mA.





$I_Z = 15mA$ (initial)

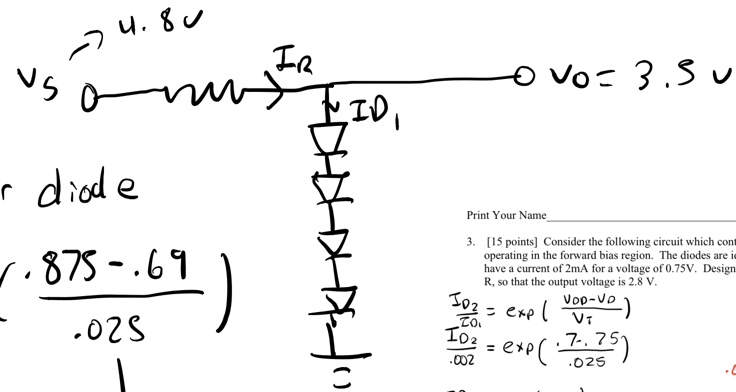
$V_{ZO} = \underbrace{V_Z}_{4.7} - \underbrace{I_Z}_{15mA} \underbrace{R_Z}_{10\Omega}$

modified $V_{ZO} = 4.55v$

$V_Z = \underbrace{V_{ZO}}_{4.55} + \underbrace{I_Z}_{.020} \underbrace{R_Z}_{10} = 4.55 + (0.02)(10) = 4.75v$

$R = \frac{12 - 4.75}{0.020} = 362.5\Omega$

5.



.875v per diode

$$\frac{ID_2}{ID_1} = \exp\left(\frac{.875-.69}{.025}\right)$$

$$ID_2 = .005\exp(\quad)$$

$$\overset{I_R}{ID_2} = 8.18A$$

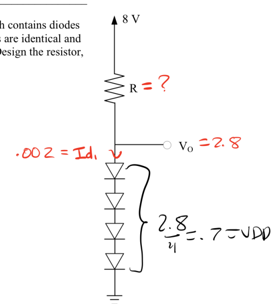
$$R = \frac{4.8-3.5}{8.18A}$$

$$R = .158\,\Omega$$

$$ID = \frac{4.8 - .73v}{.158} \Rightarrow ID = 25.76A$$

Print Your Name______________________________________

3. [15 points] Consider the following circuit which contains diodes operating in the forward bias region. The diodes are identical and have a current of 2mA for a voltage of 0.75V. Design the resistor, R, so that the output voltage is 2.8 V.



$$\frac{I_{D_2}}{I_{D_1}} = \exp\left(\frac{V_{DD}-V_D}{V_T}\right)$$

$$\frac{I_{D_2}}{.002} = \exp\left(\frac{.7-.75}{.025}\right)$$

$$I_{D_2} = .002(.135)$$

$$I_{D_2} = .00027A$$

$$R = \frac{8-2.8}{.00027A} = 19.21\,k\Omega$$

$$V_{D_2} = 0.7$$

$$V_{D_1} = 0.75$$

$$I_{D_2} = I_{D_1}\exp\left(\frac{V_{D_2}-V_{D_1}}{V_T}\right)$$