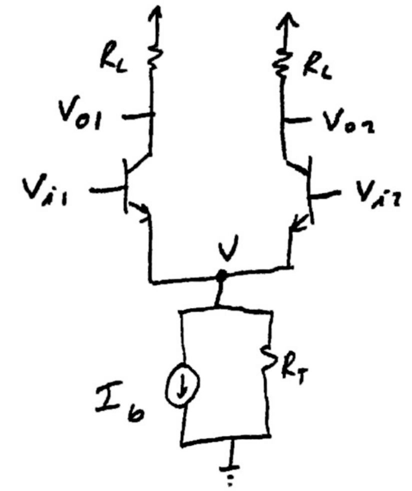
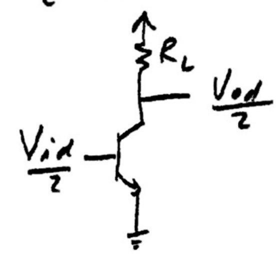
Find A_{dm}, A_{cm}, and CMRR.



For A_{dm} → Differential Half Mode Circuit
(Node V is an AC ground) $r_o \to \infty$



$$A_{dm} = -g_m\, r_o \| R_L = -g_m R_L$$

For g_m → $g_m = \frac{I_C}{U_T}$

Note → in DC, $I_{E1} = \frac{1}{2} I_b$

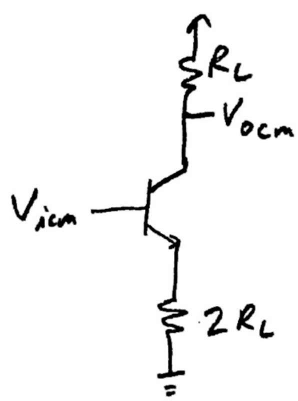
$\therefore I_{C1} = \alpha I_{E1}$

$$\alpha = \frac{\beta}{1+\beta} = \frac{100}{101} = 0.99$$

$$A_{dm} = -\frac{(\alpha)\frac{1}{2} I_b R_L}{U_T} = \frac{-(0.99)(1mA)(10k\Omega)}{(2)(25.9mV)} =$$

$$\boxed{A_{dm} = 191}$$

Common-Mode Half Circuit



Again $I_C = \frac{1}{2}\alpha I_b$

$$A_{cm} = -\frac{\beta R_L}{r_\pi + (1+\beta)(2R_T)}$$ → Similar to CE Amp with emitter degeneration

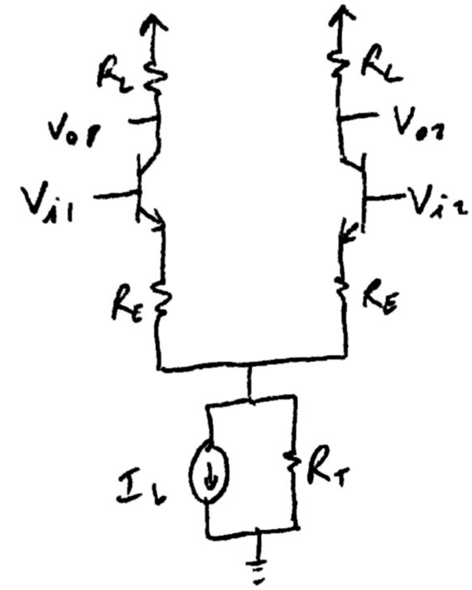
$$r_\pi = \frac{\beta}{g_m} = \frac{\beta U_T}{\frac{\alpha}{2} I_b}$$

$$A_{cm} = \frac{-\beta R_L}{\frac{2\beta U_T}{\alpha I_b} + (1+\beta)(2R_T)} =$$

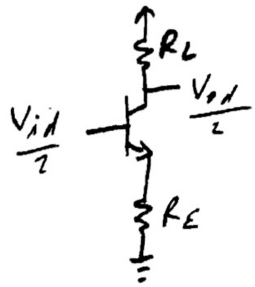
$$= \frac{-(100)(10k\Omega)}{\frac{(2)(100)(25.9mV)}{(0.99)(1mA)} + (101)(2)(2k\Omega)} = \boxed{-2.44}$$

$$CMRR = \frac{|A_{dm}|}{|A_{cm}|} = \frac{191}{2.44} = \boxed{78.28}$$

Find A_{dm}, A_{cm}, and CMRR



Differential Half-Mode Circuit



$$A_{dm} = \frac{-\beta R_L}{r_\pi + (1+\beta)(R_E)}$$

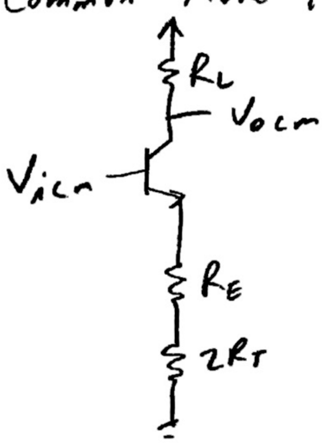
(looks like a CE Amp with emitter degeneration)

Note $r_\pi = \frac{\beta}{g_m} = \frac{\beta U_T}{I_C}$

$$r_\pi = \frac{\beta U_T}{\frac{\alpha}{2} I_b} = 5.23\,k\Omega$$

$$\therefore \boxed{A_{dm} = -9.41}$$

Common-Mode Half Circuit

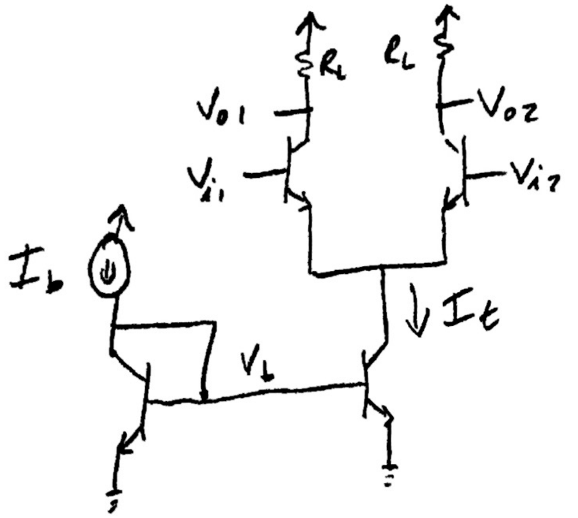


$$A_{cm} = \frac{-\beta R_L}{r_\pi + (1+\beta)(R_E + 2R_T)} = \boxed{-1.96}$$

$$CMRR = \frac{|A_{dm}|}{|A_{cm}|} = \boxed{4.8}$$

Not nearly as large as the previous case

Find A_{cm}, A_{dm}, and CMRR

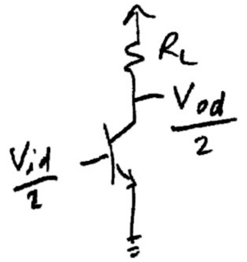


Note. I_b is a DC current source.

$\therefore V_b$ is a constant DC voltage

As a result, the ouput impedance of the current mirror is r_o

Differential-Mode Half Circuit



Same as part A except for the DC bias current

I_t = output current of the current mirror

$$I_t = \frac{I_b}{1+\frac{2}{\beta}} \quad \text{(current mirror equation)}$$

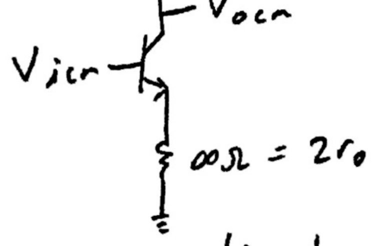
$$\therefore I_t = \frac{1mA}{1+\frac{2}{100}} = 0.98mA$$

$$\therefore g_m = \frac{I_c}{U_T} = \frac{\frac{1}{2}I_t}{U_T} = 18.93\,mS$$

$$r_\pi = \frac{\beta U_T}{\frac{1}{2}I_t} = 5.28\,k\Omega$$

$$A_{dm} = -g_m R_L = \boxed{-189}$$

Common-Mode Half Circuit

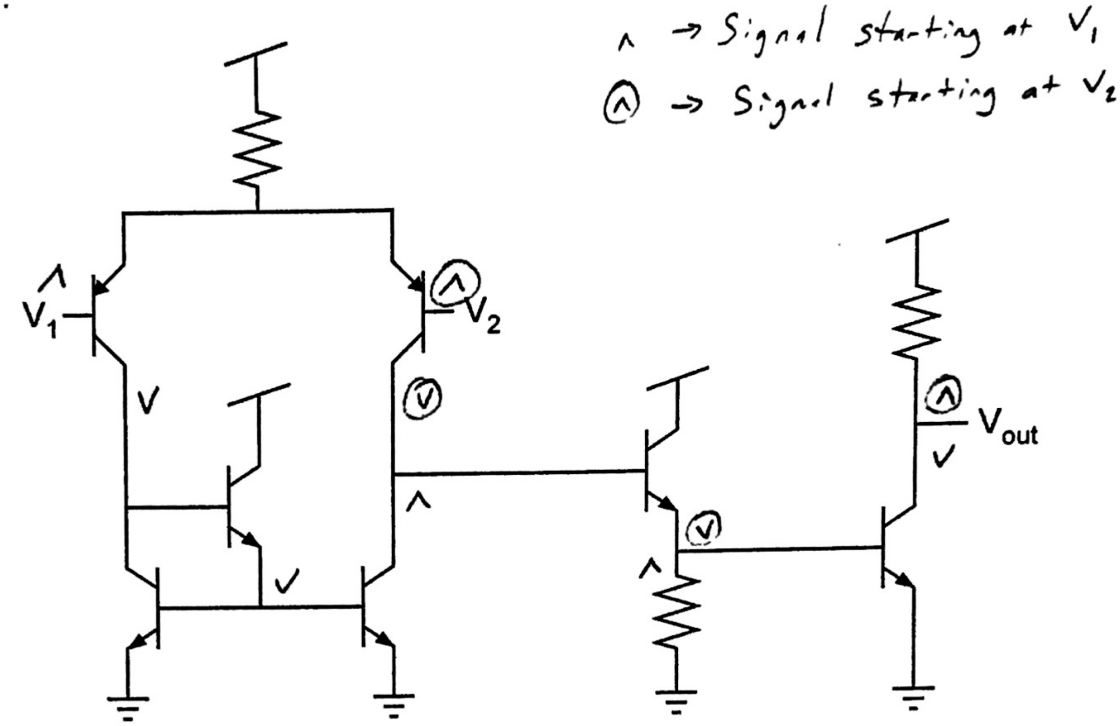


$$A_{cm} = \frac{-\beta R_L}{\frac{2\beta U_T}{\alpha I_b} + (1+\beta)(2r_o)} = \boxed{0}$$

$r_o \to \infty$

$$CMRR = \frac{|A_{dm}|}{|A_{cm}|} = \boxed{\infty}$$

Determine which input (V_1 and V_2) corresponds to the non-inverting and inverting terminals of the following amplifier.



$\therefore \quad V_1 = V_-$

$V_2 = V_+$