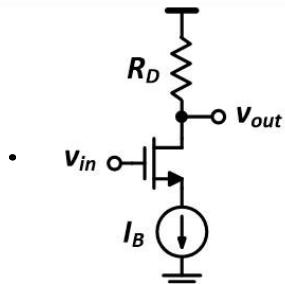


#12

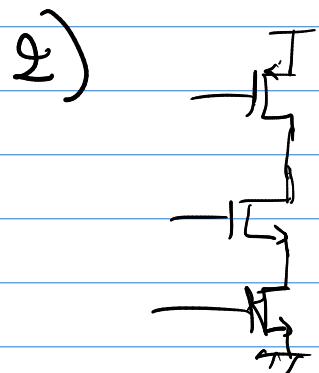


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## Thursday Analog Quiz



A newcomer to analog IC design is trying to bias a CS amplifier using a tail current source. What will be the voltage gain? If we replace RD and IB with PMOS and NMOS current sources (assume all have same  $r_o$ ), respectively, what will be the voltage gain?



if we assume all transistors have the same  $g_m$  and  $r_o$ :

$$G_m = \frac{g_m}{1 + g_m r_o}$$

$$R_{out} = g_m r_o // r_o$$

$$R_{out} = \frac{r_o}{\frac{1}{g_m} + r_o} = \frac{r_o g_m}{1 + g_m r_o}$$

$\approx r_o$

$$\text{so } A_V = -G_m R_{out}$$

$$A_V = -\frac{1}{r_o} \cdot r_o = -1$$

1) As resistance of ideal current source is infinite so  $R_S = \infty$

$$G_m = \frac{g_m}{1 + g_m R_S} \quad \text{so } G_m = 0$$

$$\text{so } A_V = 0$$