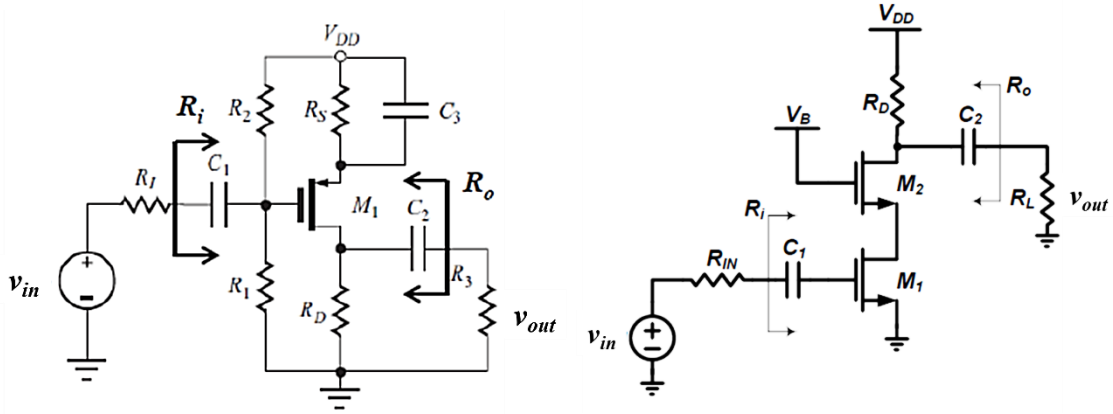
# PROBLEM SET #2

*Issued: Tuesday, Sep. 10rd, 2013*

*Due: Wednesday, Sep. 18th, 2013*, 8:00 a.m. in the EE 140/240A homework box

**1.** Use inspection analysis to write expressions for the input resistance $R_i$, output resistance $R_o$, and gain $v_{out}/v_{in}$ for each of the amplifiers in Fig PS2.1. The expressions should be in terms of the given elements and parameters of the small-signal equivalent circuits (i.e., $g_m$, $r_\pi$, $r_o$, $\beta$, etc.) for the transistors used. For each circuit, assume that all capacitors shown have infinite values.




(a) (b)

**Fig. PS2.1**

**2.** Use inspection analysis to write expressions for the input resistance $R_{in}$, output resistance $R_{out}$, and gain $v_{out}/v_{in}$ for each of the amplifiers in Fig. PS2.2. The expressions should be in terms of the given elements and parameters of the small-signal equivalent circuits (i.e., $g_m$, $r_\pi$, $r_o$, etc.) for the transistors used. For each circuit, assume that all the capacitors shown have infinite values.

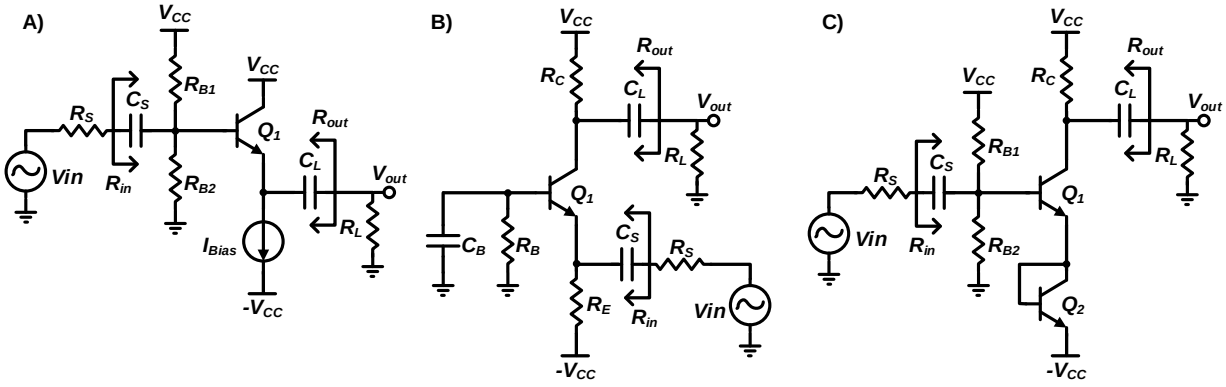



**Fig. PS2.2**

**3.** For the Darlington emitter follower of Fig. PS2.3, determine the dc collector currents in $Q_1$ and $Q_2$, and then the small-signal input resistance and voltage gain. Neglect $r_\mu$, $r_b$ and $r_o$, and assume that $V_{BE}(on)$ = 0.7V, $\beta$ = 200, $V_T$ = 26mV (at 300k). Use inspection analysis wherever possible.

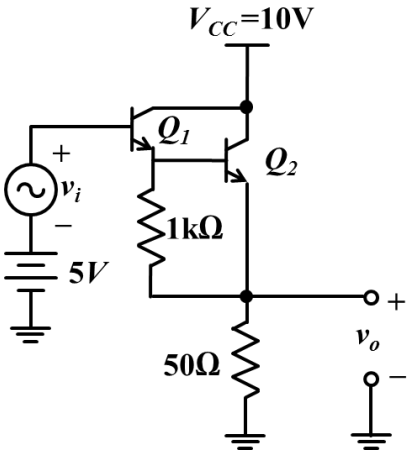



**Fig. PS2.3**

**4.** Calculate the output resistance, $R_{out}$, of the circuit in figure PS2.4 as a function of $I_{Bias}$. Do not neglect $r_{o1}$ or $r_{o2}$ in this calculation, but you may neglect $r_b$ and $r_\mu$. If $I_{C2}$ = 1mA, what is $R_{out}$ for $I_{Bias}$ = 1mA and $I_{Bias}$ = 0, assuming $V_A$ = 100V?

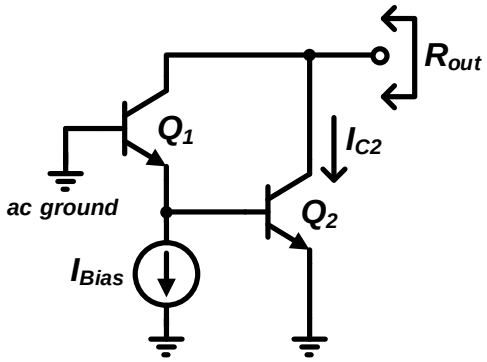



**Fig. PS2.4**