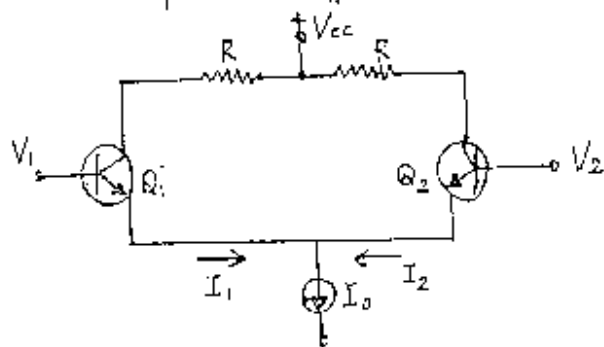


1. (a) Describe the operation principle of the npn bipolar junction transistor in the active mode. (6%)
- (b) Describe the current components of the emitter junction and collector junction, when npn bipolar junction transistor is in the active mode. (7%)
- (c) Explain and draw the profiles of minority carrier concentrations in the base and emitter of an npn bipolar junction transistor operating in the active mode. (7%)

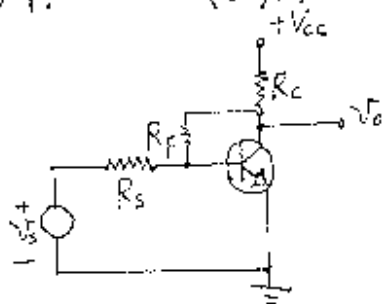
參考用

2. In general, a transistor is defined as off when only 10% of I flows in it. On the other hand, a transistor is defined as on when 90% of I flow in it.

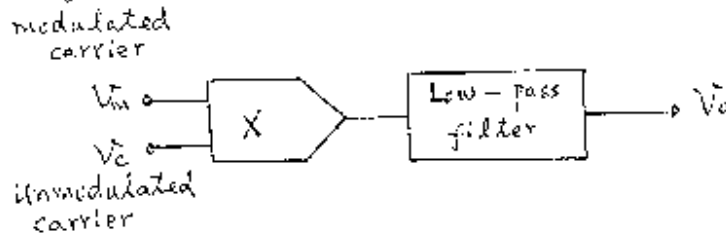
For the difference amplifier as shown, the two transistors are assumed to be identical, There is some range of input voltages, $|V_1 - V_2| \leq \Delta V$, in which both transistors will be on, i.e. in their active region, Determine this input range ΔV . (20%)



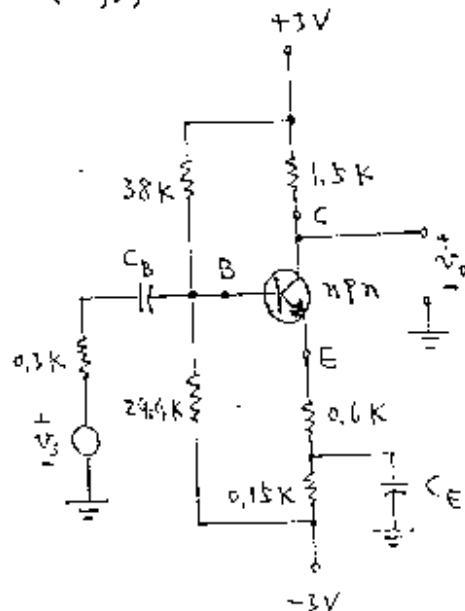
3. Assume the output resistance r_o of the transistor is infinite, Use the hybrid π equivalent circuit, feedback concept, and approximate analysis method, determine open-loop gain A_{oL} , transfer ratio β , and loop gain (or return ratio) T . (20%)



4. The input signals to the multiplier circuit shown are an AM-modulated signal $V_m = V(t) \cos \omega_c t$ and the carrier signal $V_c = V_c \cos \omega_c t$
- (a) show that V_o can be used to obtain the information $V(t)$ (10%)
- (b) If $V(t) = V_m \cos \omega_s t$, where $\omega_s \ll \omega_c$, what should the cutoff frequency of the filter be? (10%)



5. For the transistor operated in room temperature shown in figure, assume $V_{BE} = 0.7V$ and $\beta_F = 200$.
- (a) Determine the quiescent values of I_c and V_o (10%)
- (b) Assuming that C_E can be made arbitrarily large, determine C_B so that lower ± 3 -dB frequency (or lower half-power frequency) $f_L = 20 \text{ Hz}$ (10%)



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