1. In Fig. 1, let the op amp be ideal:
   (a) Please derive the transfer function (7%).
   (b) Please sketch a Bode plot for the magnitude response (10%).

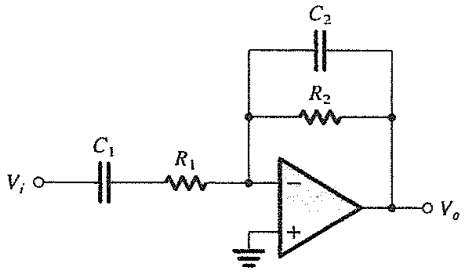

Fig. 1

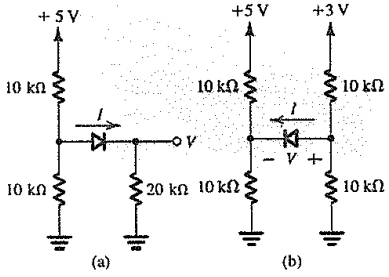

Fig. 2

2. Assuming that the diodes in the circuits of Fig. 2 are ideal, please find the values of the labeled currents and voltages (8%).
3. Consider the amplifier circuit shown in Fig. 3. The BJT has $|V_{BE}| = 0.7$ V, $\beta = 200$, $C_\mu = 0.8$ pF, and $f_T = 600$ MHz. The MOSFET has $V_t = 1$ V, $k'W/L = 2$ mA/V^2, and $C_{gs} = C_{gd} = 1$ pF.
   (a) Please determine the amplifier input resistance R_{in}, and the overall voltage gain V_o/V_{sig}. Assume r_o of both transistors to be very large (12%).
   (b) Consider the circuit at low frequencies. Please find the frequency of the poles due to C_1 and C_2, and hence estimate the lower 3-dB frequency, f_L (10%).
   (c) Consider the circuit at higher frequencies. Please use open-circuit time constants to estimate f_H (8%).

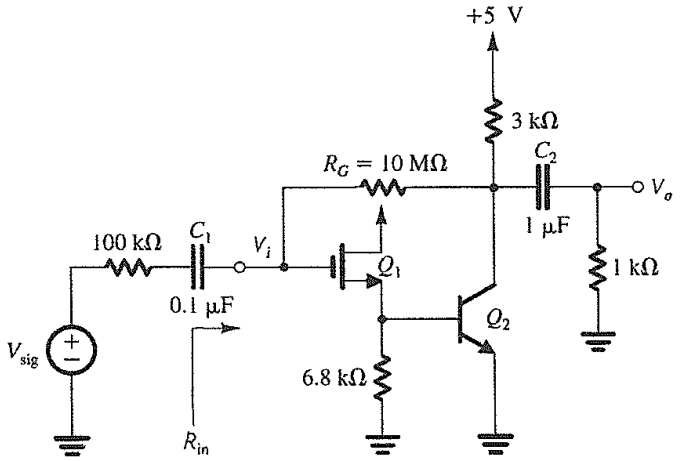

Fig. 3

4. For the current-mirror-loaded differential amplifier in Fig. 4. Assume $\beta = 100$, $|V_{BE}| = 0.7$ V, $|V_A| = 60$ V, $V_t = 0.7$ V, and $k'(W/L) = 2$ mA/V^2. Please find: (a) differential input resistance (R_{id}) (5%), (b) A_d (5%), and (c) CMRR (5%).

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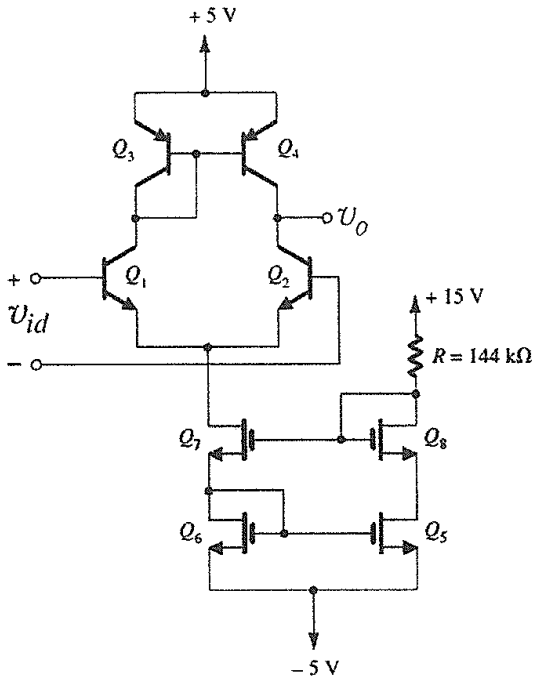

Fig. 4

5. The capacitors of Fig. 5 are uncharged. The switch is closed at t = 0 s for 8 ms. (a) Please determine v_C and i_C during charge (4%). (b) Through the charging process, are the capacitors in steady state? Please explain it 4(%). (c) Please find the magnitude of the charge and energy stored on the 10- and 40-μF capacitors at t = 8 ms, respectively (4%). After 8 ms, the switch is opened. (d) Please find v_C and i_C during discharge (4%). (e) Please estimate how long will the transient last. (4%)

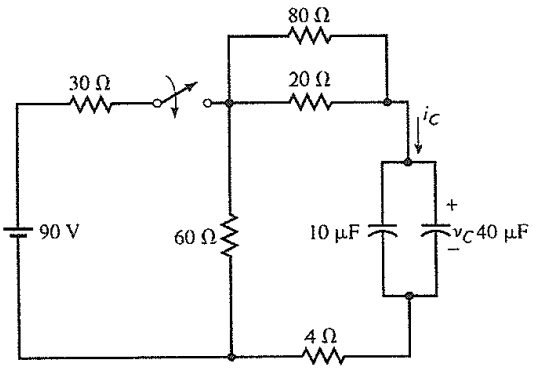

Fig. 5

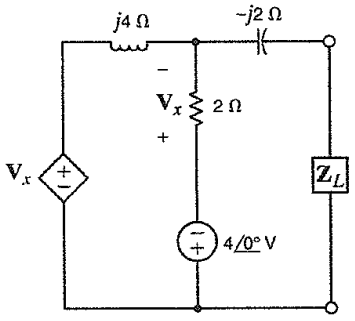

Fig. 6

6. In Fig. 6, please find Z_L for maximum average power transfer and please compute the maximum average power supplied to the load. (10%)

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