1. A D/A converter is shown in Fig. 1.

   (a) Show that the current I drawn from V_r is a constant independent of the digital word. Explain why propagation-delay time transients are eliminated with this system (6%)

   (b) What the switch current and V_o if the MSB is 1 and all other bits are zero? (4%)

   (c) Repeat (b), assuming that the next MSB is 1 and all other bits are zero. (5%)

   (d) Calculate V_o for all bits are 1. (5%)

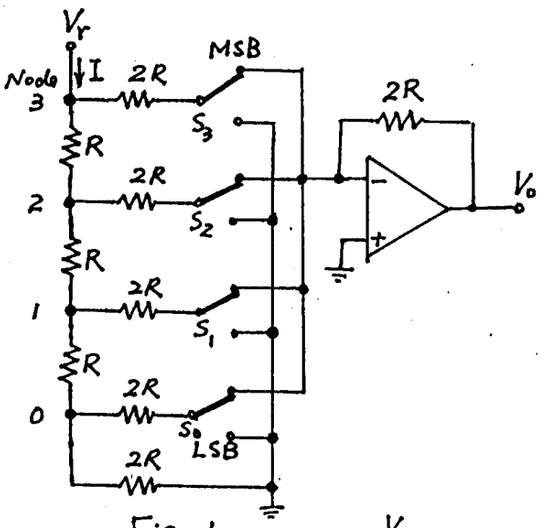

Fig. 1

2. A circuit shown in Fig. 2 uses a transistor having β_F = 100 and parameter values R_C = 0.5 kΩ, R_E = 1.0 kΩ, R_B = 44 kΩ, V_{CC} = 15 V, V_{EE} = -15 V, and V_{BB} = 0.

   (a) Determine V_{o1} and V_{o2}. (8%)

   (b) Determine the value of V_{BB} which just barely saturates the transistor. (12%)

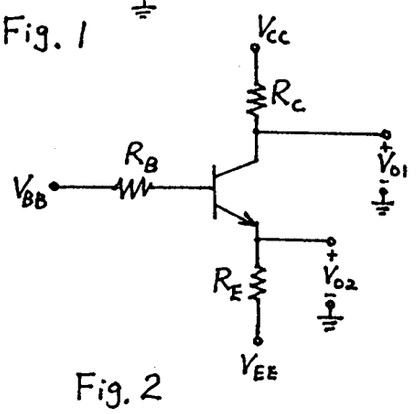

Fig. 2

3. A ECL OR gate shown in Fig. 3, assume that all transistors have $V_{BE(ON)}$ = 0.75 V and all base currents are negligible, and all diodes have V_D = 0.75 V.

   (a) Calculate the value of V_R. (4%)

   (b) Determine the logic levels, V(1) and V(0). (8%)

   (c) Calculate the noise margins, NM_H and NM_L. (8%)

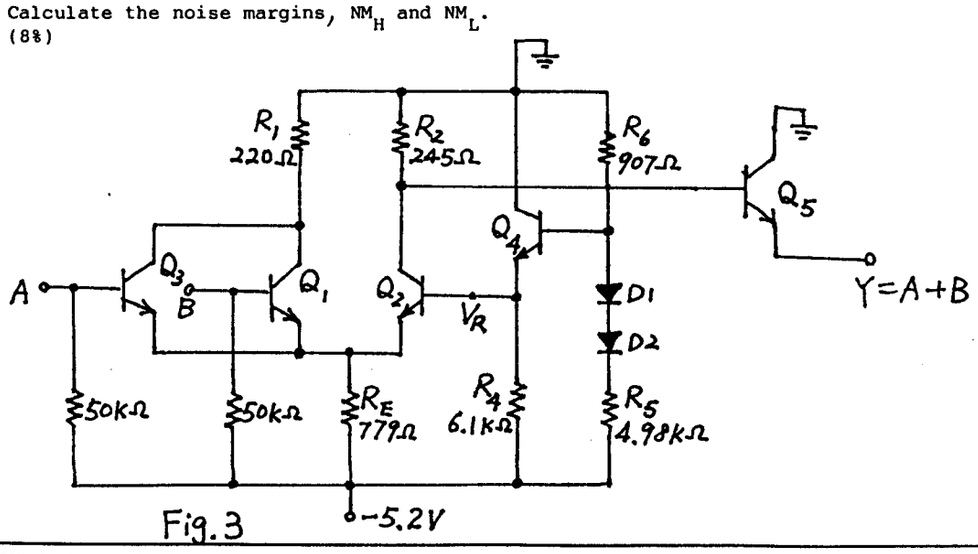

Fig. 3

4. A triangle-wave generator is shown in Fig. 4.

   (a) Calculate the peak-to-peak amplitude of the triangle wave. (10%)

   (b) Calculate the oscillation frequency of the triangle wave if $V_s \neq 0$. (10%)

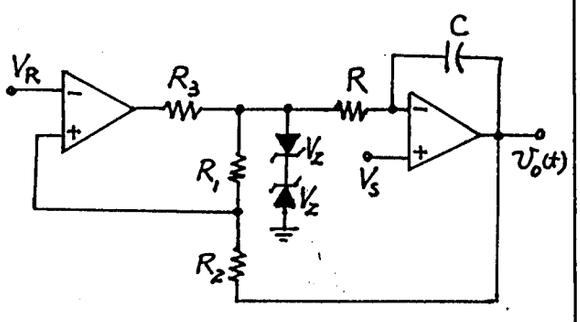

Fig. 4

5. A circuit is shown in Fig. 5. Transistor Q_1 has r_{d1} = 10 kΩ and g_{m1} = 3 m℧; Q_2 has r_{d2} = 15 kΩ and g_{m2} = 2 m℧.

   (a) Find the gain V_o/V_2 for $V_1 = 0$. (8%)

   (b) Find the gain V_o/V_1 for $V_2 = 0$. (8%)

   (c) For $v_1 = 5 \sin \omega t$ and $v_2 = -2.5 \sin \omega t$, find v_o. (4%)

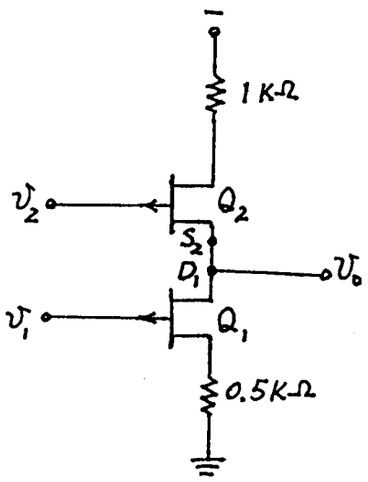

Fig. 5