1. In the basic circuit theory, the duality (對偶性) is a nature existing as the electric circuit phenomenon.
   (1) describe the Duality Law,
   (2) Figure 1 shows a DC circuit, determine the duality circuit, and be sure to indicate all terms which are shown in the circuit by Duality Law.

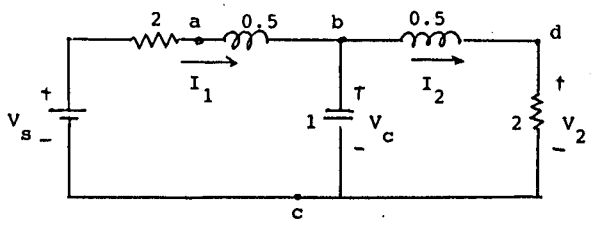

Figure 1.

2. Assume a voltage wavefor $V_{in}(t)$ is sinusoidal, and varies with its center null from 0 V to 6 V by one step. $V_{in}(t)$ is shown in Figure 2.a.
   (1) draw the input waveforms for these two cases,
   (2) describe the V_o of Figure 2.b with two $V_{in}(t)$ cases,
   (3) describe the V_o of Figure 2.c with two $V_{in}(t)$ cases,
   (4) describe the V_o of Figure 2.d with two $V_{in}(t)$ cases.

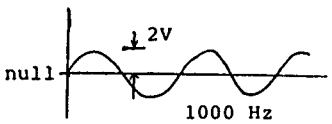

Figure 2.a

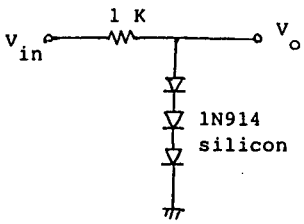

Figure 2.b

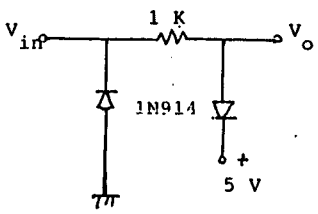

Figure 2.c

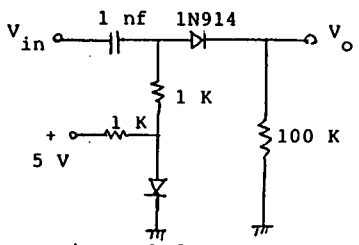

Figure 2.d

3. The transistor 2N3904 and FET 2N5457 are made of silicon material, their data are shown:
   2N3904: h_{ie} = 3.5 K-Ohm, h_{re} = 1.3 x 10^{-4}, h_{fe} = 120, h_{oe} = 8.5 Micro-Mho;
   2N5457: g_m = 4275 Micro-Mho.
   (1) calculate I_e.

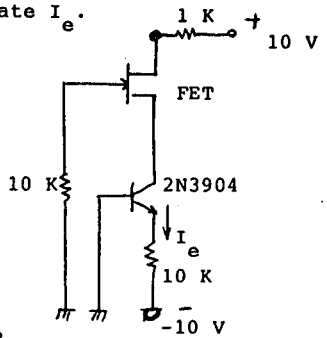

Figure 3.

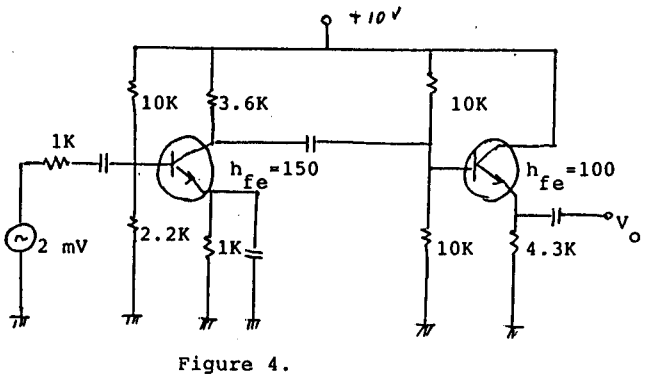

Figure 4.

4. A two stage amplifier, the first stage is a CE amplifier, the second stage is an Emitter follower, is shown in Figure 4. From the calculation, the first stage has been known as: A = -159, Z_{in} = 1.18 K-Ohm, Z_o = 3.6 K-Ohm.
   (1) draw the AC equivalent circuit specified all components,
   (2) calculate the output voltage when the input voltage is 2 mV.