1. The diode cut-in voltage is $V\gamma = 0.7$ V in the circuits shown in Figure 1. Find the diode current I_D and diode voltage V_D. (10%)

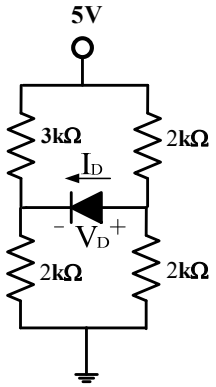

Figure 1

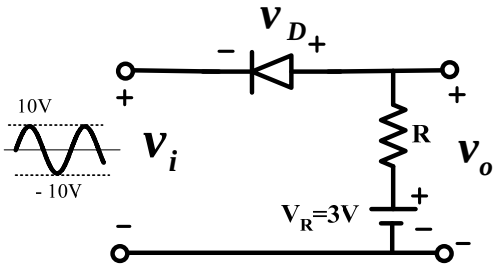

Figure 2

2. Consider the circuit in Figure 2. Assume the diode cut-in voltage is $V_\gamma = 0$V. Sketch v_D versus time, v_o versus time and v_o versus v_i. (15%)

3 For the circuit in Figure 3, the transistor parameters are $V_{BE(on)} = 0.7$ V, $\beta = 180$, and $V_A = \infty$.

(a) Determine the *Q*-point values. (b) Find the small-signal parameters g_m, $\mathbf{r}_\pi$ and $\mathbf{r}_O$. (c) Find the small-signal voltage gain $A_v = v_o/v_s$. (20%)

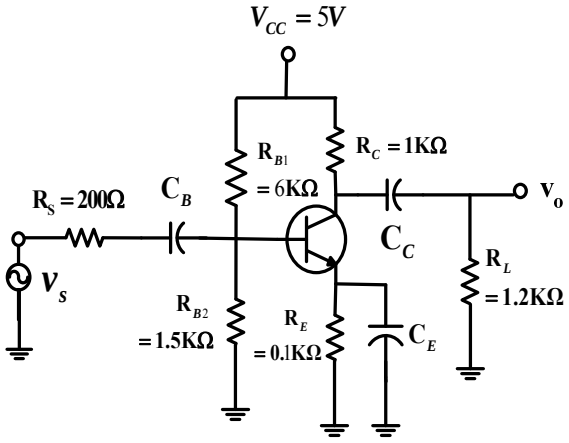

Figure 3

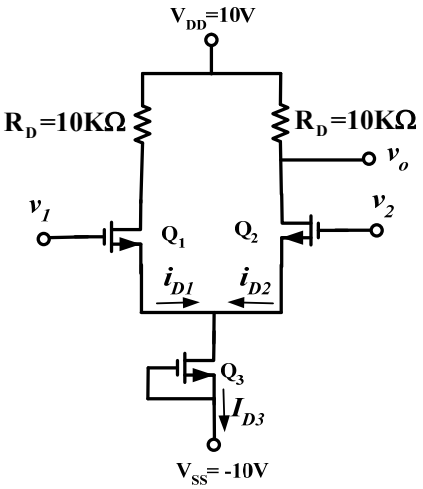

Figure 4

4. For the differential amplifier in Figure 4, the transistor parameters are $k_{n1} = k_{n2} = 2$ mA/V^2, $k_{n3} = 1$ mA/V^2, $V_{th1} = V_{th2} = 2V$, $V_{th3} = 1V$, and $\lambda_1 = \lambda_2 = \lambda_3 = 0$. (a) Determine I_{D1}, I_{D2} and I_{D3}. (b) Determine the differential-mode voltage gain A_d. (20%)

5. Consider the oscillator in Figure 5. Find the values of R_1 and R_2 that will produce sustained oscillations at 10Hz. (10%)

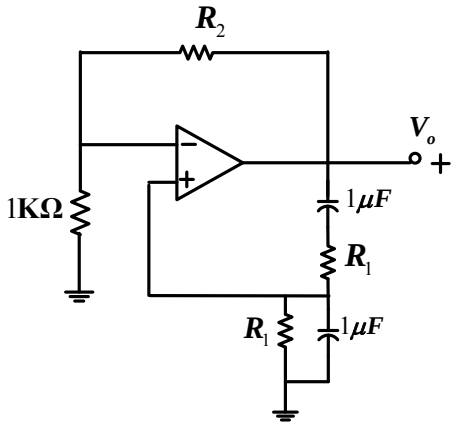

Figure 5

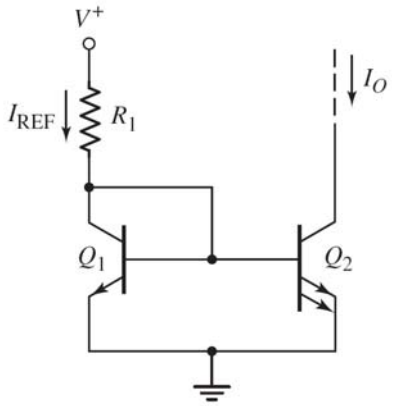

Figure 6

6 Consider the circuit shown in Figure 6. The transistor $Q2$ is equivalent to two identical transistors in parallel, each of which is matched to $Q1$. Assume the transistor parameters are $V_{BE(on)}$ = 0.7 V, β = 60, and V_A =∞, and assume the bias voltage is V+ = 2.5 V. Design the R1 of circuit such that I_O = 0.50 mA and determine the value of I_{REF}. (10%)

7. The op-amp in the noninverting amplifier configuration in Figure 7 has a slew rate of 1 V/μs. Sketch the output voltage versus time for each of the three inputs shown. The op-amp is biased at ±10 V. (15%)

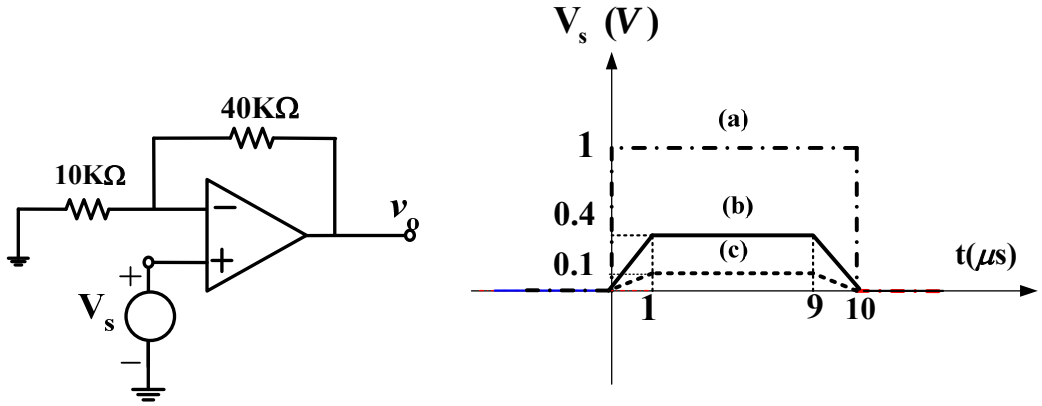

Figure 7