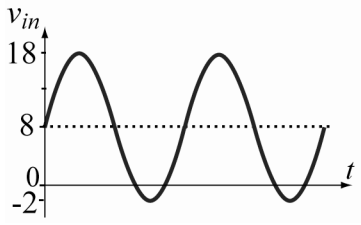
1. (5%) If $V_{D(ON)}$=0.7V, draw the output waveform $v_{out}(t)$



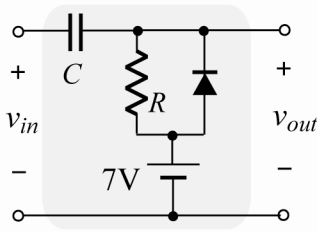


Fig.1

2. (10%) Logic circuits are shown in Fig. 2 and Fig. 3. Write down the Boolean functions of Y in terms of A and B?

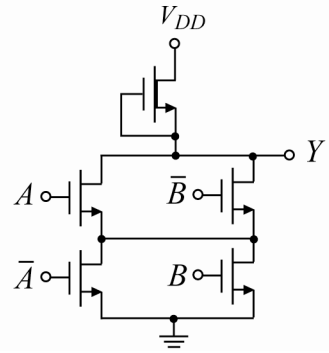


Fig. 2

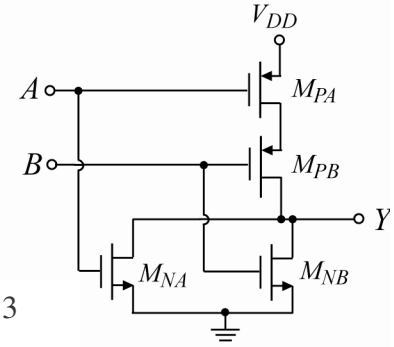


Fig. 3

3. (1) Draw the OP-Amp Wien bridge oscillator circuits with the components R_1, R_2, R_3, R_4, $C_1$and C_2. (5%)
   (2) Determine the resistances ratio of the OP-Amp required (3%), and the oscillation frequency. (2%)

4. Fig. 4 shows a common-emitter circuit. The circuit parameters are：β=100, R_C=6kΩ, R_B=50kΩ, V_{CC}=12V, V_{BB}=1.5V, V_{BE}=0.7V, V_T=26mV, V_A= ∞ and $v_i(t)$=0.5sinωt(V). Calculate the maximum and minimum values of $i_C(t)$ and $v_O(t)$. (10%) Draw one cycle of the waveforms $i_C(t)$ and $v_O(t)$ (5%) .

5. Fig. 5 shows an NMOS IC amplifier with enhancement load. The parameters are：V_{T1}=1V, V_{T2}=2V, W_1=45μm, W_2=24μm, L_1=5μm, L_2=6μm, and $\mu_n C_{ox}$=100μA/V^2, where V_T , W, L, μ_n, and C_{ox} are the threshold voltage, the channel width, the channel length, the mobility of the electrons in the inversion layer, and the oxide capacitance per unit area, respectively.
   (1) Calculate the dc bias point (V_O and I_D) with V_{DD}=10V, V_{GS}=3V. (8%)
   (2) Calculate the small signal voltage gain A_v= v_o/ v_i. (2%)

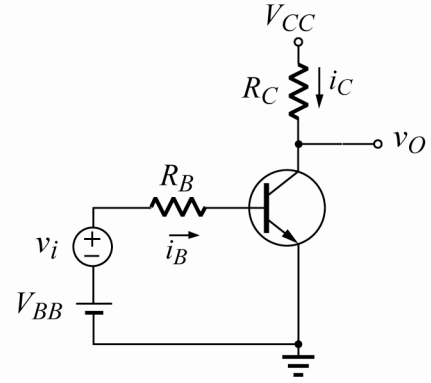


Fig. 4

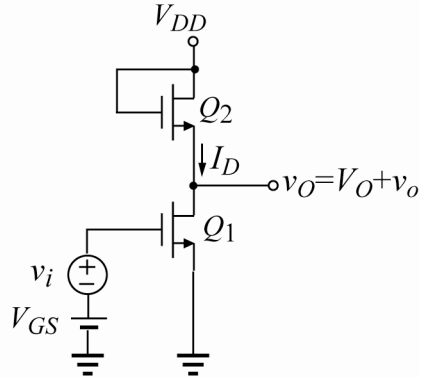


Fig. 5

6.

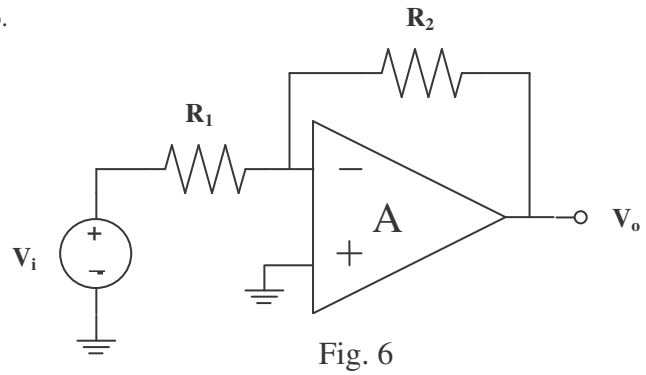


Fig. 6

The circuit shown in Fig. 6 is an inverting amplifier. The resistance of R_1, R_2 are 1kΩ,10KΩ respectively. Find the voltage gain V_o/V_i of this amplifier in each of the following cases.

(a) OPA gain A=∞(3%)

(b) $A=10^5$.(4%)

(c)$A=A(s)=\dfrac{A_0}{1+\dfrac{s}{\omega_0}} = \dfrac{10^5}{1+\dfrac{s}{2\pi\times 10}}$, what is the cutoff frequency of this inverting amplifier?

(8%)

7.

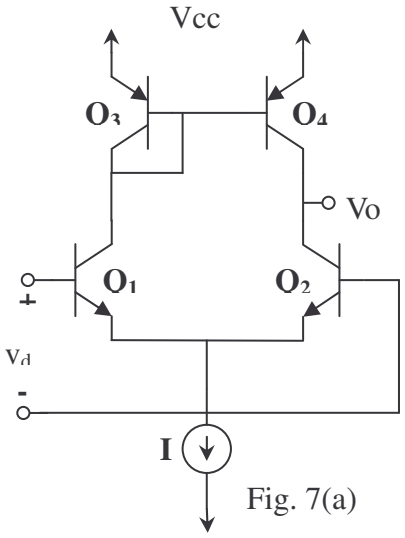


Fig. 7(a)

For the active-loaded differential amplifier of Fig. 7(a) when biased with a current I= 0.5 mA, if the transistors has current gain β = 200, Early voltage V_A = 100V, suppose the small-signal operation of the amplifier can be modeled by the models shown in Fig. 7(b), find the value of the differential input resistance R_i, transconductance G_m and output resistance R_o.(10%)

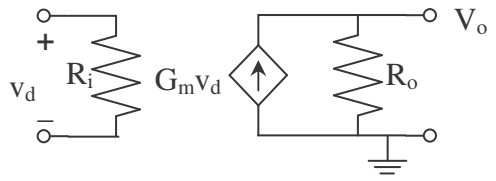


Fig. 7(b)

8.

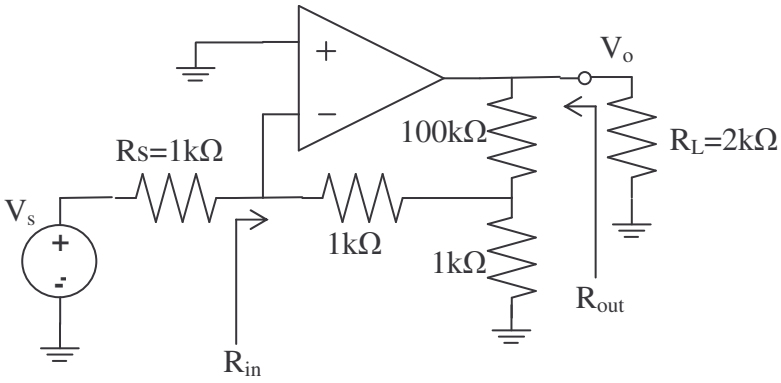


Fig.8

There are four basic feedback topologies of a feedback amplifier. Determine the feedback topology of the circuit displayed in Fig. 8 and find the voltage gain V_o/V_s, input resistance R_{in} and output resistance R_{out} by using the feedback method. The values of the related parameters of the OPA are specified as follows, the open loop gain $\mu = 10^4$ V/V, differential input resistance R_{id} = 100kΩ and output resistance r_o= 1kΩ.(15%)

9.

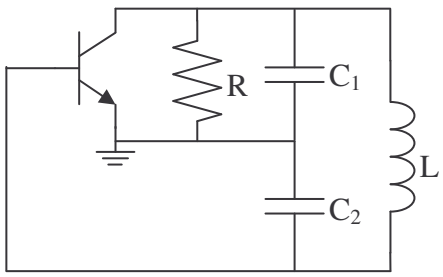


Fig. 9

The circuit in Fig. 9 is a Colpitts oscillator, show that the resonance frequency ω_0 is

$$\omega_0 = \frac{1}{\sqrt{L\dfrac{C_1C_2}{C_1+C_2}}}$$

(10%)