

(Due by Nov. 16 by 6pm in homework locker)

1. (a) The triangular signal of Fig. 1(a) is input to the class A amplifier of Fig. 1(b). The amplifier has the following parameters: $V_{CC}=5V$, $V_{BE}=0.7V$ (assume constant), $V_{CE,sat}=0.3V$, $R_L=2k\Omega$, and the bias current is designed to be $I=V_{CC}/R_L$. Sketch the output voltage v_o .

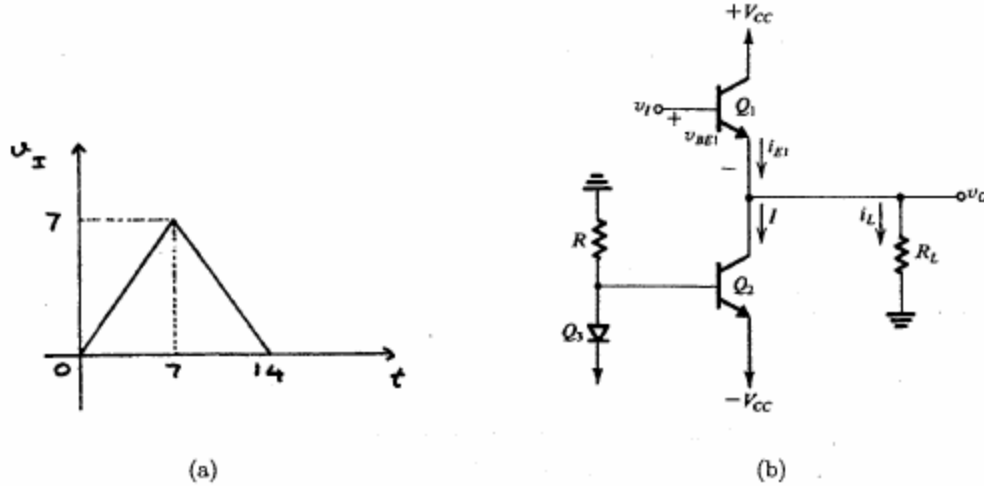
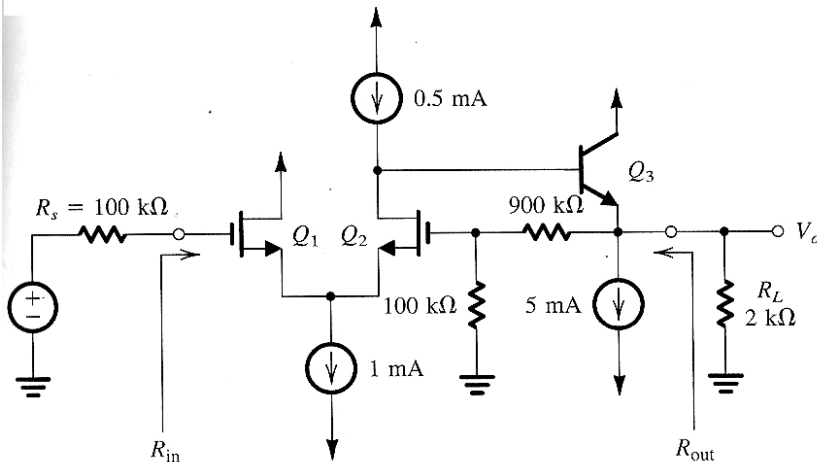


Fig. 1 (a) Input, (b) Output Stage

(b) What type of feedback is employed in the circuit below:



(c) We discussed three types of power amplifiers or output stages in class: **Class A**, **Class B**, and **Class AB**.

Which type has the worst distortion? _____

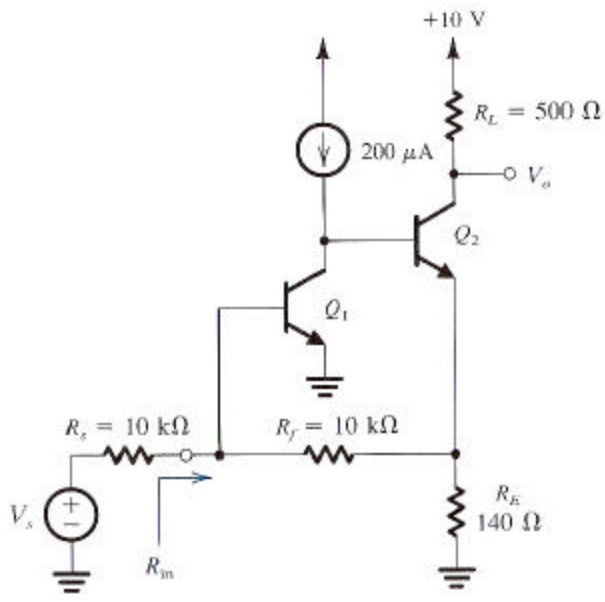
Which type has the highest power efficiency? _____

Which type has the lowest power efficiency? _____

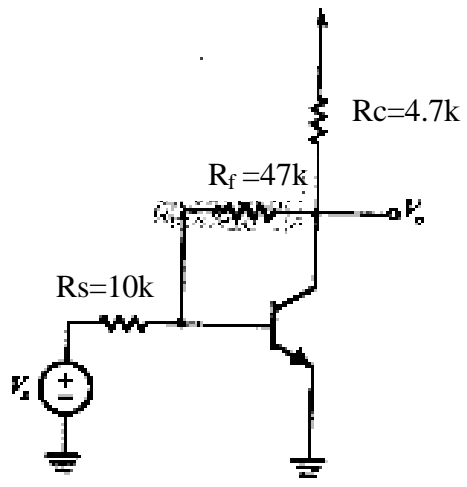
(d) If we put a square wave into a feedback amplifier, and the output shows too much ringing for our application, is the phase margin too high or too low? _____

2. An amplifier has a dc gain of 10^5 and high-frequency poles at 10^5 Hz, 3.16×10^5 Hz, and 10^6 Hz. For a phase margin of 45° find the value of β and the corresponding closed-loop gain.

3. Consider the amplifier below. When the source voltage V_s has zero dc component, the output dc voltage is $V_o = 5V$. Let both BJTs have $\beta = 50$, and assume constant $V_{BE} = 0.7V$ for both BJTs. Determine the dc voltages at all nodes and the dc emitter currents of Q_1 and Q_2 . Use feedback analysis to find V_o/V_s and R_{in} .



4. Consider the circuit shown below. The transistor has $\beta = 100$, and is biased so that the dc operating point is $I_B = 0.015mA$, $I_C = 1.5mA$, and $V_o = 4.7V$. Determine the small-signal loop gain.



5. Consider a feedback amplifier for which the open-loop gain $A(s)$ is given by

$$A(s) = \frac{1000}{(1 + s/10^4)(1 + s/10^5)^2}$$

If the feedback factor β is independent of frequency, find the frequency at which the phase shift is 180° , and find the critical value of β at which oscillations will commence. (Hint: A good initial guess for the desired frequency is 10^5 rad/sec.)

6. The datasheet of the PN2222A bipolar transistor contains the following information:

Maximum allowable junction temperature $T_{Jmax} = 150^{\circ}\text{C}$

Maximum power dissipation $P_{Dmax} = 625 \text{ mW}$ at ambient temperature $T_A = 25^{\circ}\text{C}$

Junction-to-case thermal resistance $\theta_{JC} = 80^{\circ}\text{C/W}$

(a) Draw an equivalent electrical circuit for this thermal system. Label all components as well as the junction temperature T_J , the case temperature T_C , and the ambient temperature T_A . (Note that we are not using a heat sink in this problem.)

(b) Find the case-to-ambient thermal resistance θ_{CA} .

(c) Assuming an ambient temperature of 25°C , what is the case temperature T_C when the transistor dissipates 500 mW?

7. Exercises 12.31 and 13.18