

# UNIVERSITY OF CALIFORNIA AT BERKELEY

College of Engineering  
Department of Electrical Engineering and Computer Science

R. Brodersen

EE140

Oct. 15, 2003

Midterm Exam

Name:

SID:

Use the following parameters:

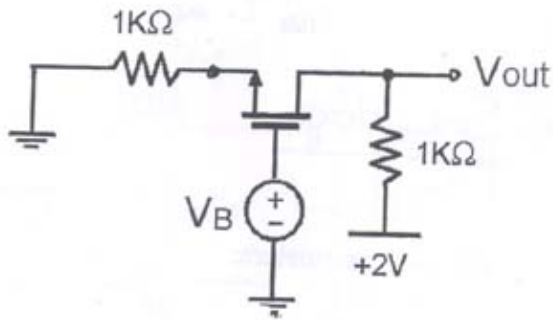
$$V_{t0(\text{NMOS})} = V_{t0(\text{PMOS})} = 0.4\text{V}$$

$$K'(\text{NMOS}) = K'(\text{PMOS}) = 10\text{mA/V}^2 = 10^{-2}\text{ A/V}^2$$

$$F_f = 0.3\text{V}; \quad \gamma = 1\text{V}^{1/2}; \quad \lambda = 0.02$$

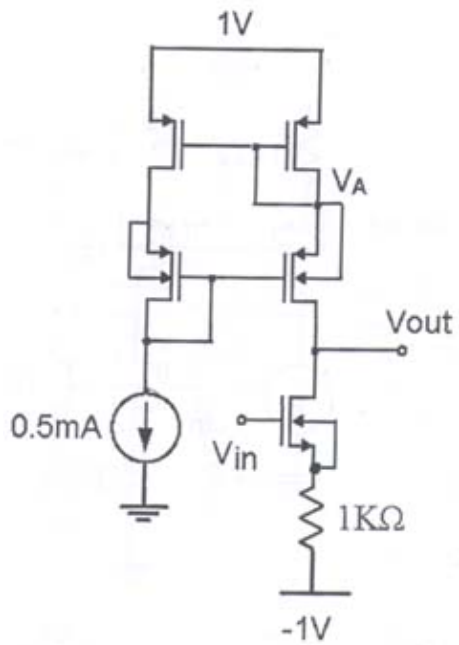
Assume all  $W/L = 10$

1.



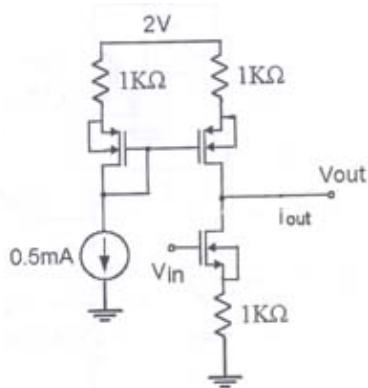
What is  $V_B$  so that  $V_{\text{out}} = 1.5\text{V}$ ?  $V_B =$

2.



- a. What is the voltage at  $V_A$ ?
- b. What is the maximum swing in the positive direction at  $V_{out}$ ?
- c. What is the most negative swing at  $V_{out}$ ?

3.

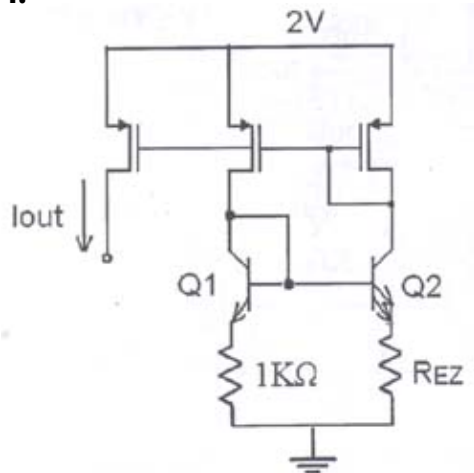


- a. What is  $G_m = i_{out} / V_{in}$  ?

b. What is  $R_{out}$  ?

c. What is  $A_v$  ?

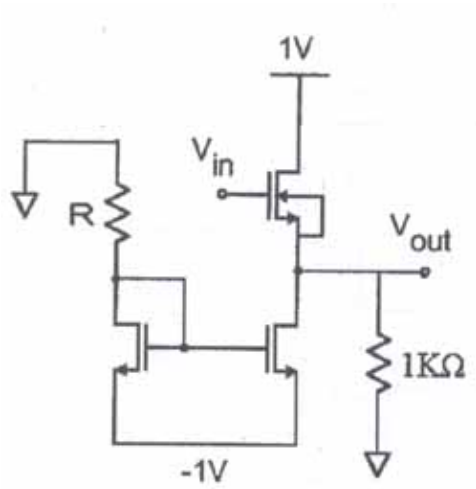
4.



For the bipolar:  $A_E = 1$  for Q1  
 $A_E = 4$  for Q2  
 $V_{th} = 26mV$

What is the value of  $R_{EZ}$  that sets  $I_{out} = 10 \mu A$  ?  $R_{EZ} =$

5.



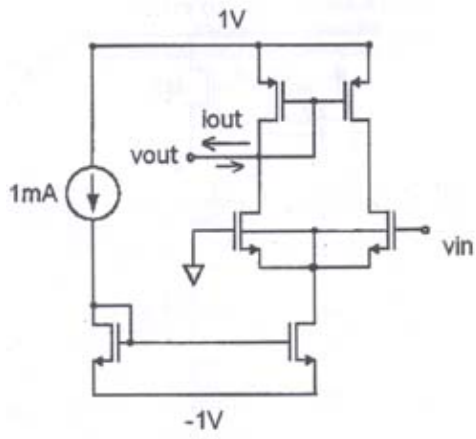
$$-1V \leq V_{in} \leq 1V$$

What is the value of  $R$  which gives the maximum efficiency?

$R =$

(Hint: Find an expression for  $R$  before you plug in numbers)

6.

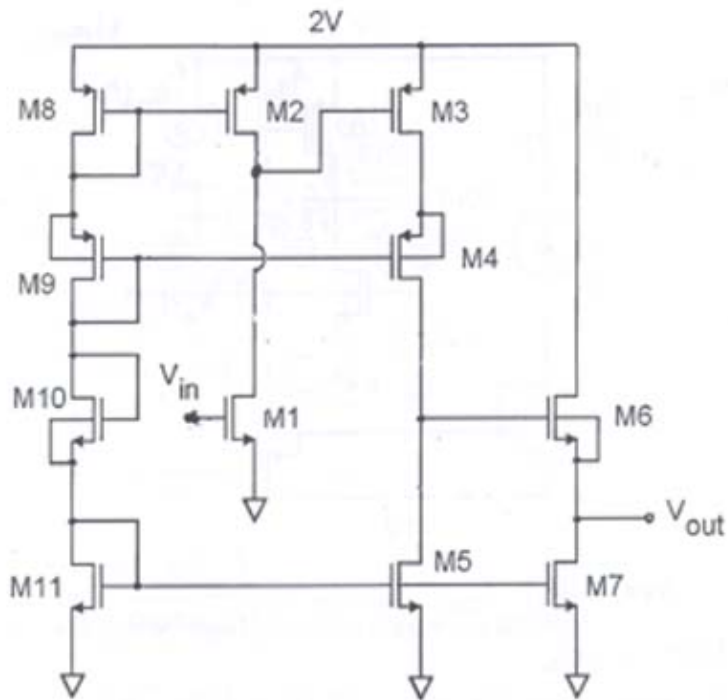


a. What is  $G_m$ ?

b. What is  $R_{out}$ ?

c. What is  $A_v$ ?

7.



a. What is the  $I_{ds}$  of transistor M6?

b. Assume that  $g_m = 0.01$ ,  $r_o = 100k$ ,  $g_{mb} = 0$ , for all the transistors.  
What is  $V_{out} / V_{in}$  ?