

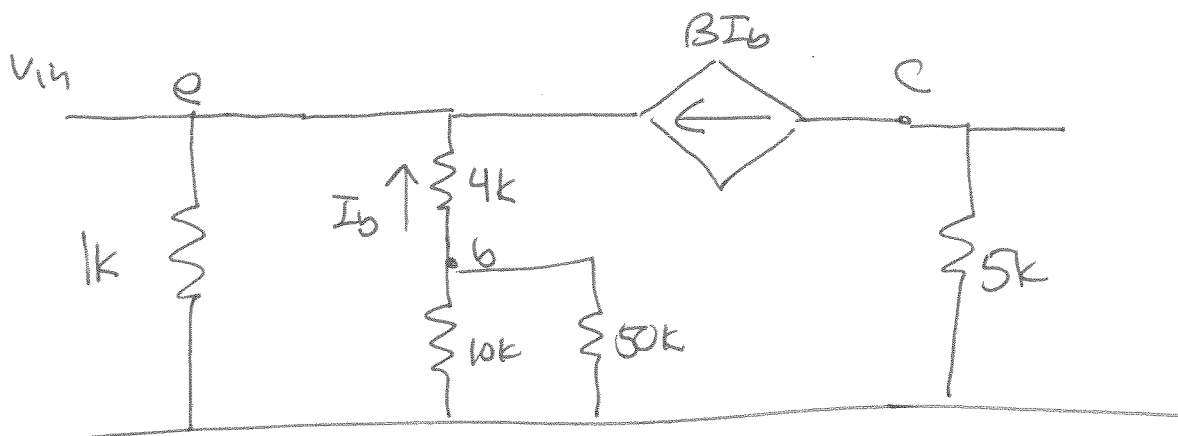
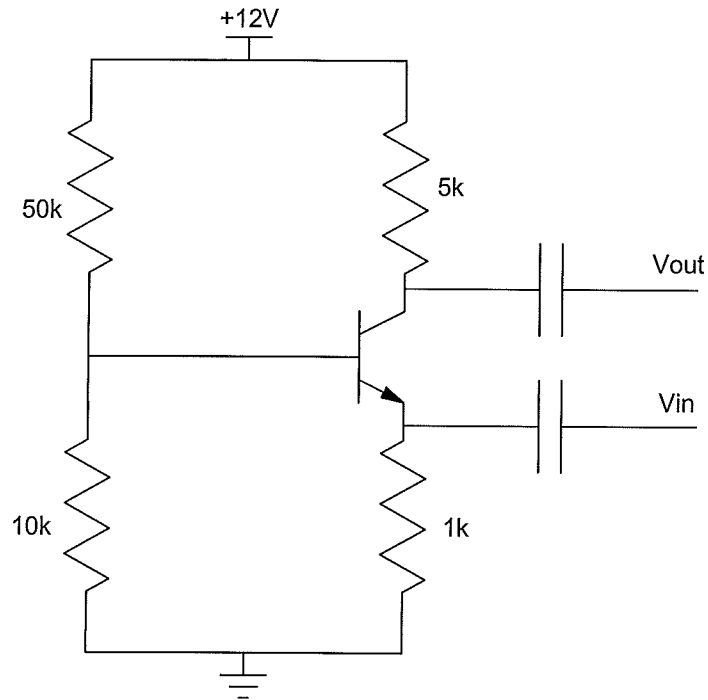
ECE 321 - Quiz #5: Name _____

CB - CC - CS Amplifiers. May 5, 2016

1) Draw the small signal model (AC model) for a comon-base amplifier where the base capacitor has been removed.

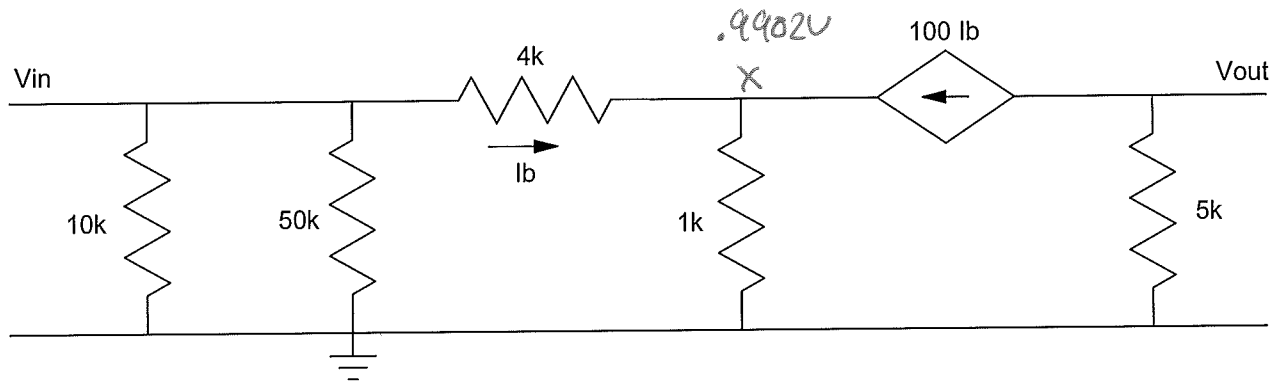
Assume

- $\beta = 100$
- $r_f = 4k\Omega$



2) Find the 2-port model for the following CE amplifier:

Rin	Ai	Rout	Ao
9.77k 7720	○	5k	26.225 3.28 -4.76



$$R_{in}: 10k \parallel 50k \parallel 10k + 4k = \cancel{9.77k} 7720$$

A_o :

$$\frac{X-1}{4k} + \frac{X}{1k} + \frac{100(X-1)}{4k} = 0$$

$$\left(\frac{1}{4k} + \frac{1}{1k} + \frac{100}{4k}\right)X = \left(\frac{1}{4k} + \frac{100}{4k}\right)$$

$$X_1 = \cancel{.9902} .9619$$

$$I_b = \frac{1-X}{4k} = \cancel{24.5\mu A} 6.56\mu A$$

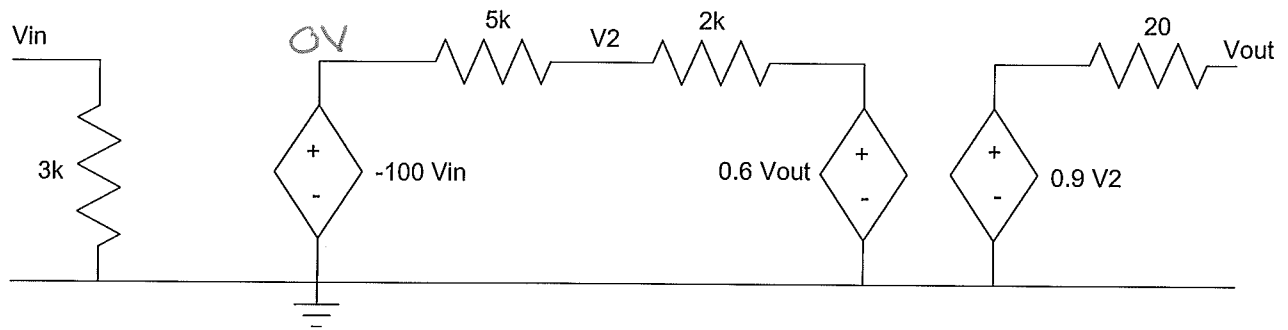
$$100I_b = \cancel{2450\mu A} 656\mu A 952\mu A$$

$$V_o = -100I_b 5k$$

$$= \cancel{-1.225V} 3.28$$

3) Find the 2-port model for the following CE : CC amplifier

Rin	Ai	Rout	Ao
3k	0	32.56	341.86



Rout :

$$V_2 = \left(\frac{5}{7}\right)(.6) = .4286V$$

$$.9V_2 = .3857V$$

$$I = \frac{1 - .3857}{20}$$

$$R = \frac{20}{I}$$

Ao :

$$V_2 = \frac{20}{5} \left(-\frac{200}{7} + \left(\frac{5}{7}\right)(.6V_0) \right)$$

$$V_0 = .9V_2$$

$$V_2 = -\frac{200}{7} + \left(\frac{5}{7}\right)(.6)(.9)V_2$$

$$V_2 = -346.51$$

$$V_0 = .9V_2 = -341.86$$

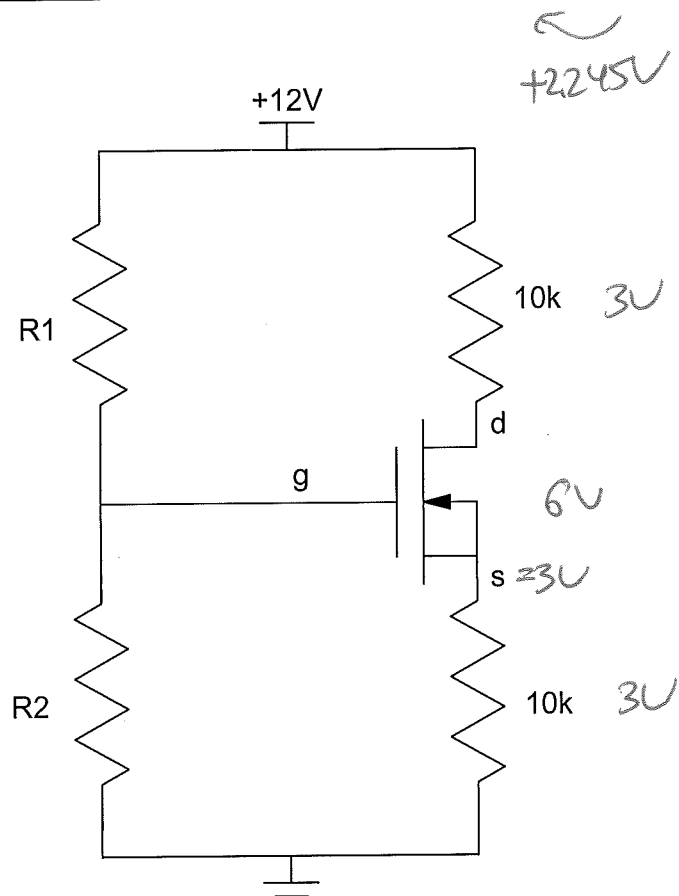
4) For the following MOSFET amplifier, assume

- $k_n = 0.01 \frac{A}{V^2}$
- $V_{th} = 2V$
- $I_{ds} = \frac{k_n}{2}(V_{gs} - V_{th})^2$

Find R1 and R2 so that

- the Q-point is $V_{ds} = 6V$, and
- $R1 \parallel R2 = 100k \text{ Ohms}$

R1	R2	Vg	Vs
177k	228k	5.245V	3V



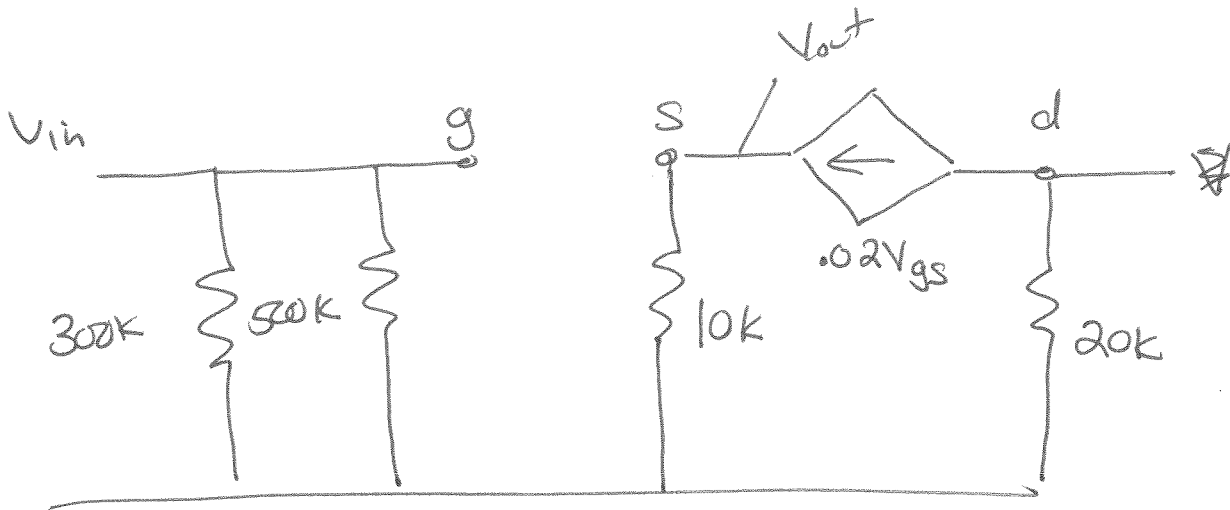
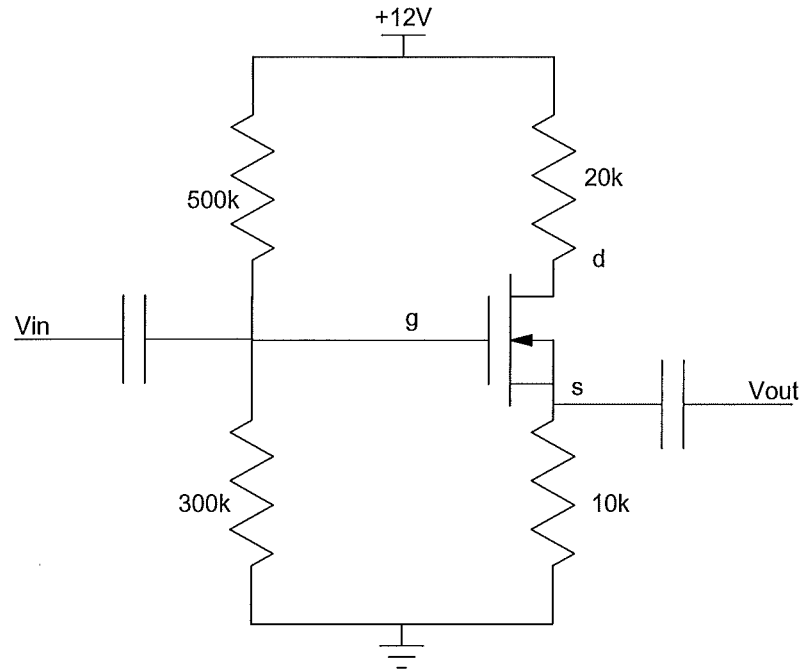
$$I_{ds} = \frac{3V}{10k} = 300 \mu A$$

$$I_{ds} = \frac{k_n}{2}(V_{gs} - V_{th})^2$$

$$V_{gs} = 2.245V$$

5) Draw the small-signal model for the following MOSFET CD amplifier. Assume that

$$g_m = \frac{dI_{ds}}{dV_{gs}} = 0.02 \frac{A}{V}$$



Bonus: Godzilla / Bernie Sanders Trivia! Which is more:

- The number of elections Bernie Sanders has lost, or
- The number of battles Godzilla has lost?