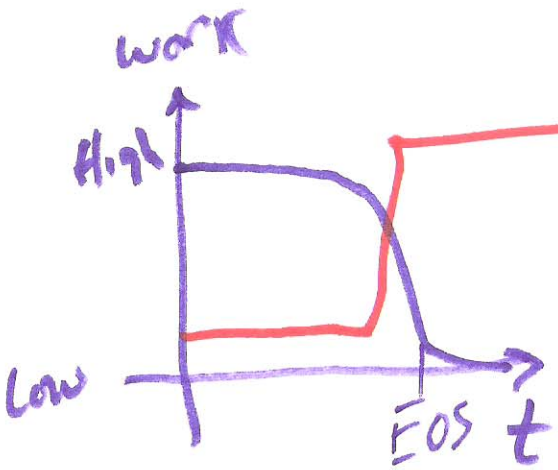
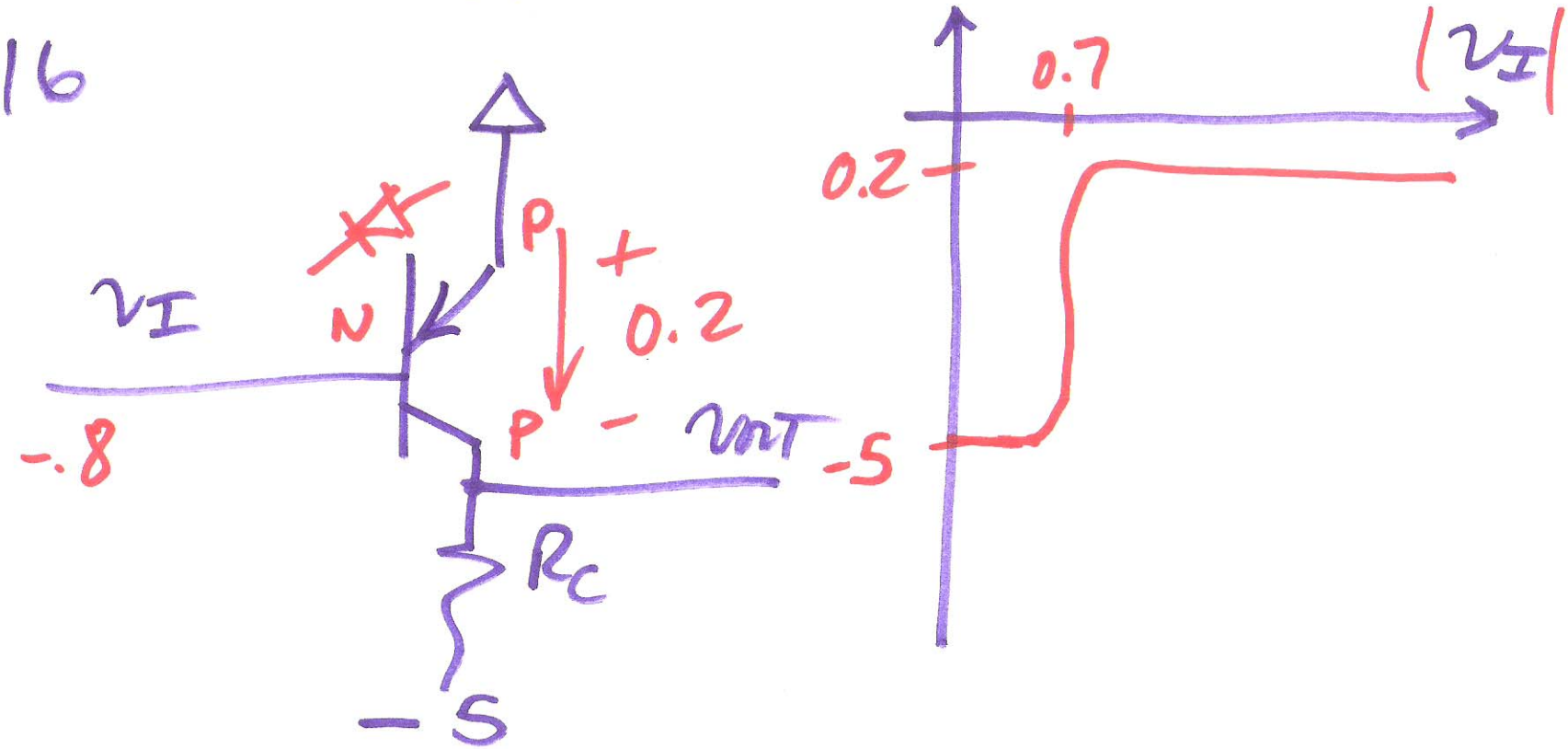


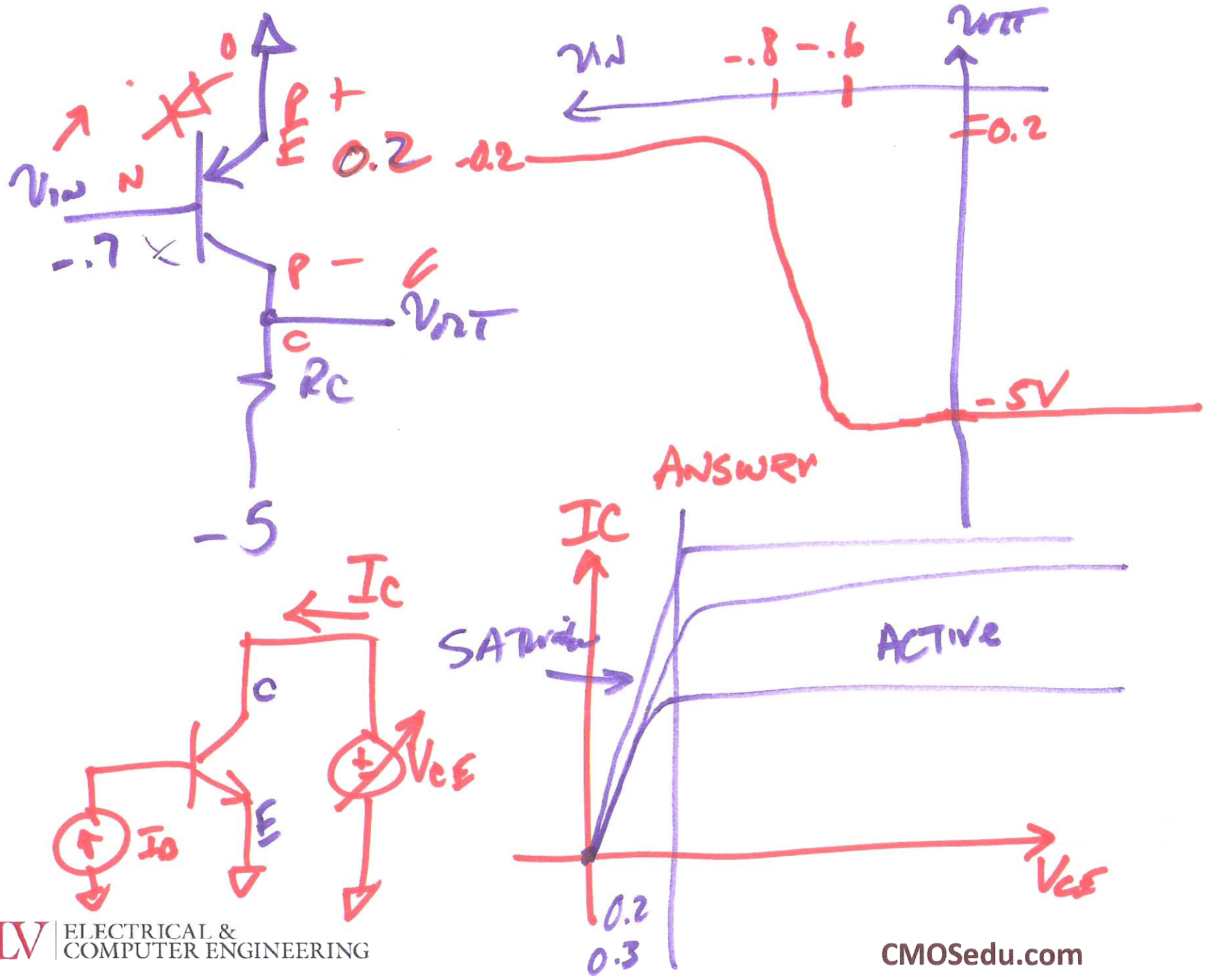
EE 320 Engineering Electronics I

April 22, 2015

Lecture 24

7.16





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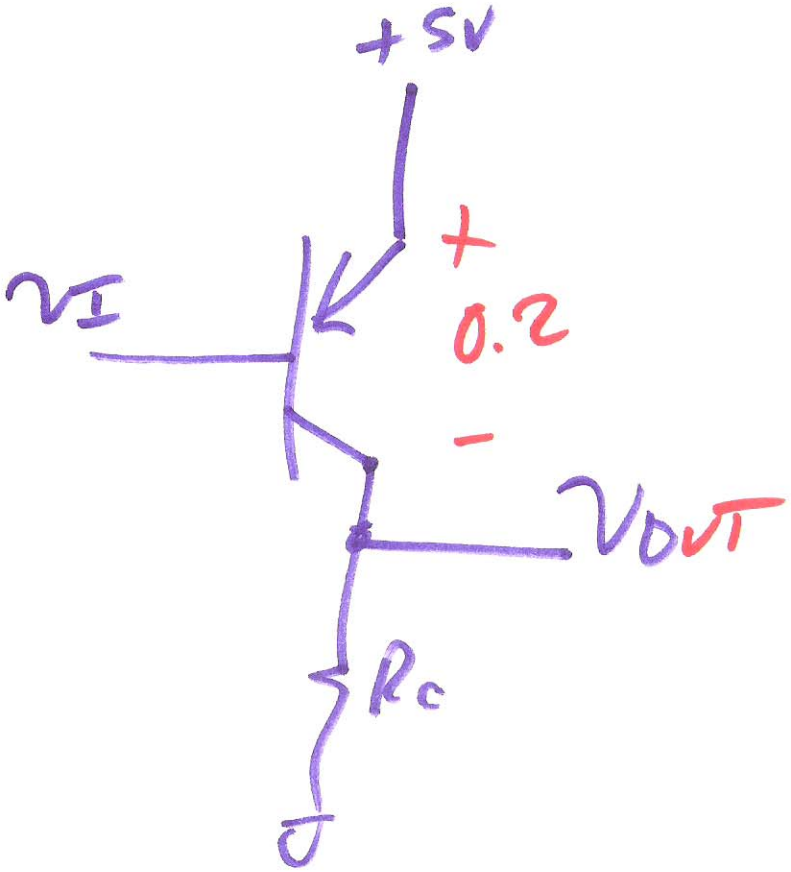
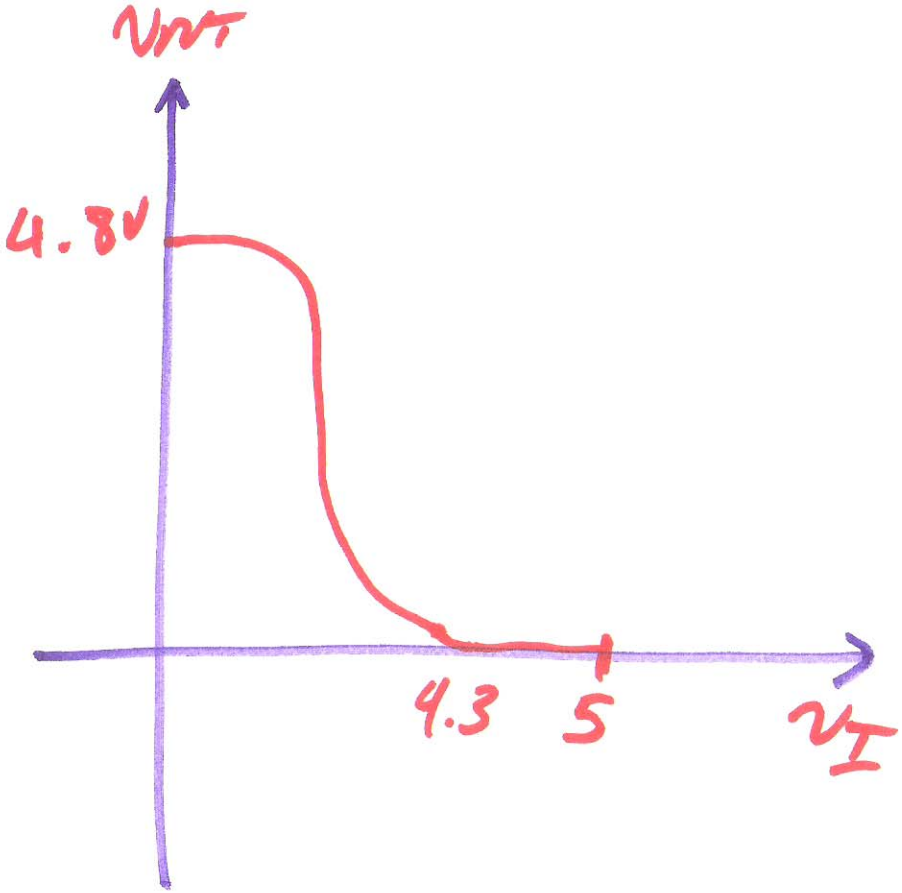
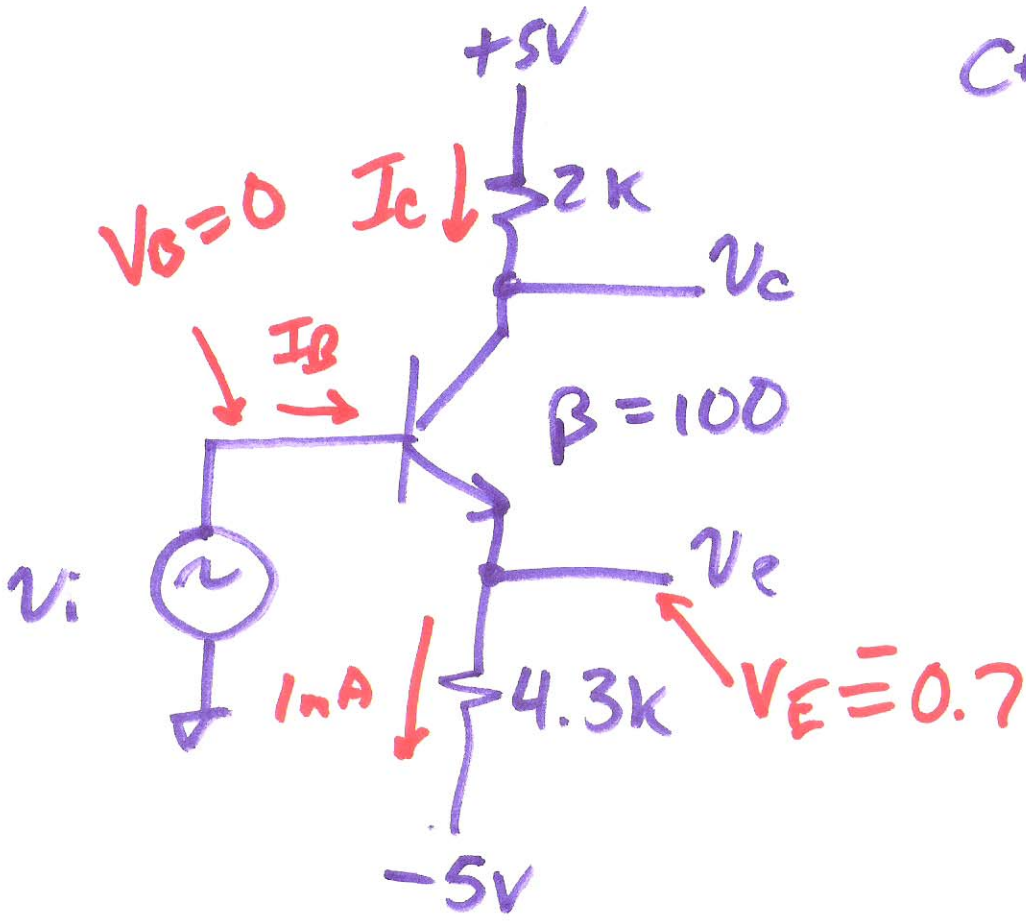
2)


+5V
+
0.2
−
v_I
v_{OUT}
R_C


v_{OUT}
4.8V
4.3
5
v_I



DC

Calculate DC of

$\frac{v_c}{v_i}$ $\frac{v_e}{v_i}$

$$I_E = \frac{-0.7-(-5)}{4.3k} = 1mA$$

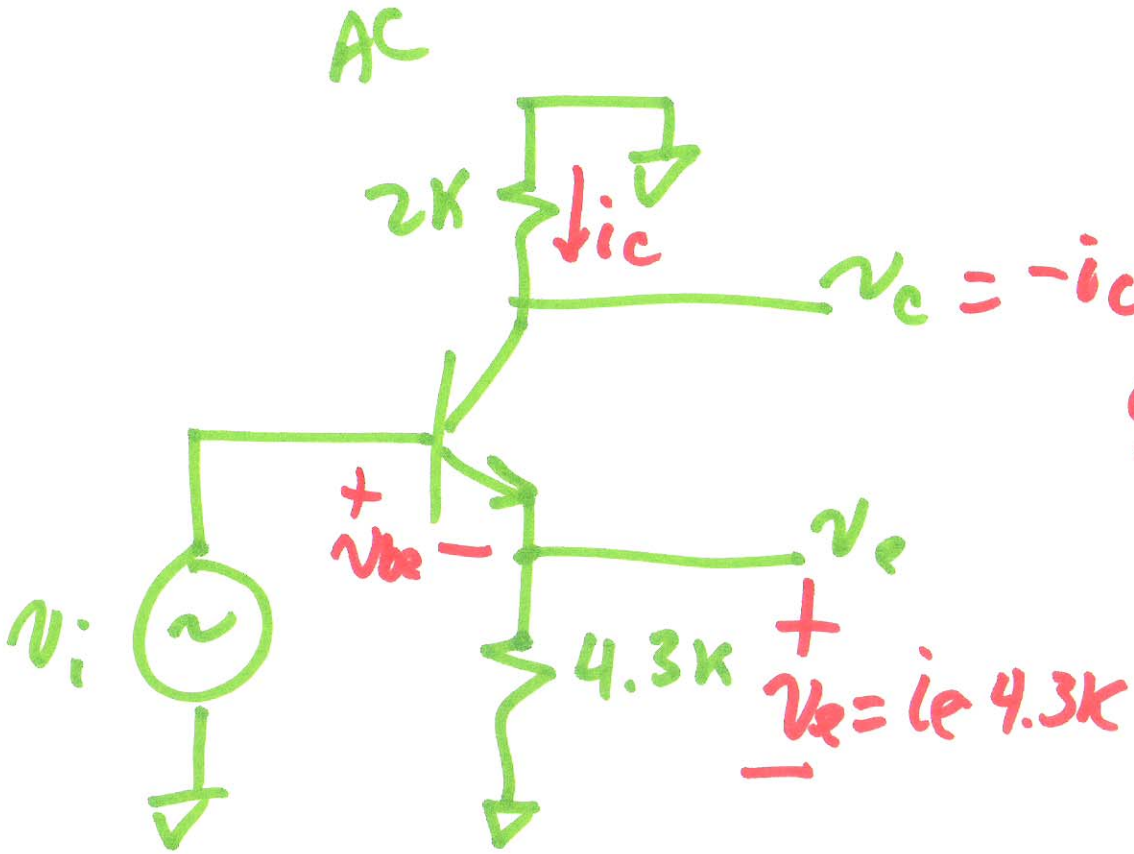
$$I_B = \frac{I_E}{\beta+1} = 9.9_4 A$$

$$I_C = I_B \cdot \beta = I_e \cdot \alpha$$

$$= 990_4 A$$

$$V_C = 5 - I_C \cdot 2k$$

$$\simeq 3V$$



$\frac{v_c}{v_i}$ $\frac{v_e}{v_i}$

$v_c = -i_c \cdot 2K$

$g v_{be} = i_c$

$g = \frac{I_C}{NV_T} = \frac{1\text{mA}}{1.25\text{mV}} = 40\frac{\text{mA}}{\text{V}}$

$v_e = i_e 4.3K$

$i_b \cdot r_{be} = v_{be}$

$i_e \cdot r_e = v_{be}$

$v_i = v_{be} + v_e$

$v_i = i_e \cdot r_e + i_e \cdot 4.3K$

$r_e = \frac{NV_T}{I_E}$, $r_{be} = \frac{NV_T}{I_B}$ $\frac{v_e}{v_i} = \frac{i_e \cdot r_e}{i_e(r_e + 4.3K)}$

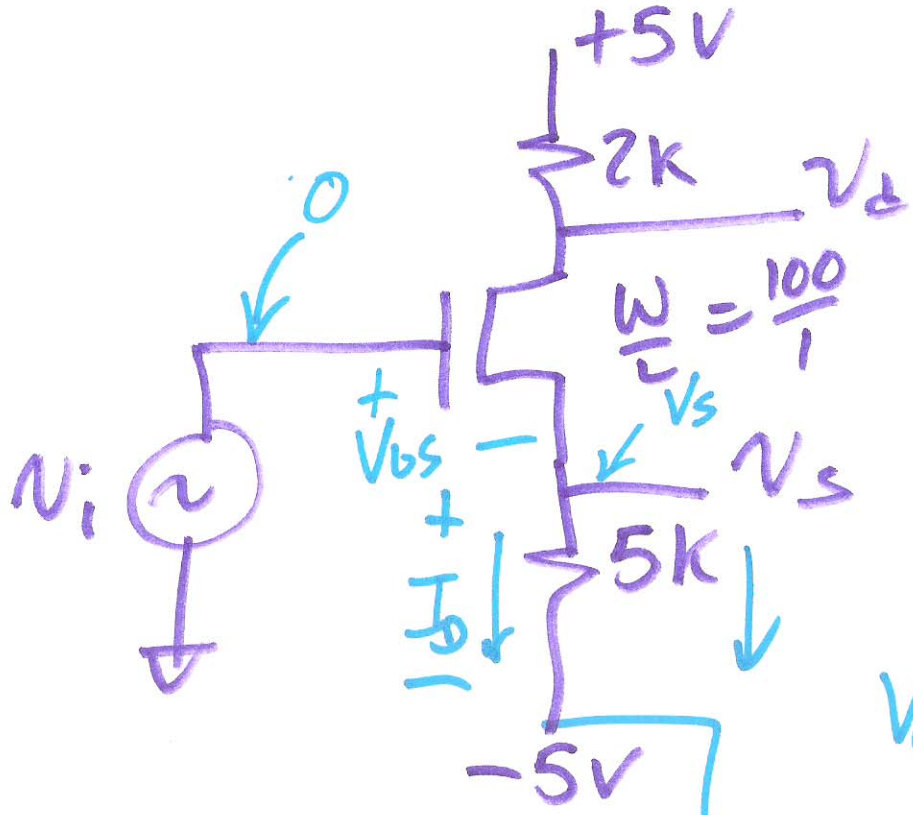
$$\frac{v_c}{v_i} = \frac{-i_c \cdot 2k}{i_e (r_e + 4.3k)}$$

$$\frac{i_c}{i_e} = \alpha \simeq 1$$

$$\frac{v_c}{v_i} = \frac{-2k}{\alpha (r_e + 4.3k)}$$

$$r_e = \frac{nV_T}{I_E} = \frac{1.25mV}{1mA} = 25\Omega$$

6)



$$V_{GS} = (0 - V_S) = (I_D \cdot 5K - 5V)$$

$$I_D = \frac{K_{PN}}{2}\frac{W}{L}(V_{GS} - V_{THN})^2$$

$$I_D = \frac{5mA}{V^2}(5 - I_D \cdot 5K - 1)^2$$

$$I_D = \frac{100\mu A}{V^2}\cdot\frac{1}{2}\cdot\frac{100}{1}(I_D \cdot 5K - 5 - 1)^2$$

$$200 I_D = (4 - I_D \cdot 5K)^2$$

$$16 - 40K I_D + 25 \cdot 10^6 \cdot I_D^2$$

$$25 \cdot 10^6 I_D^2 - 40.2k I_D + 16 = 0$$

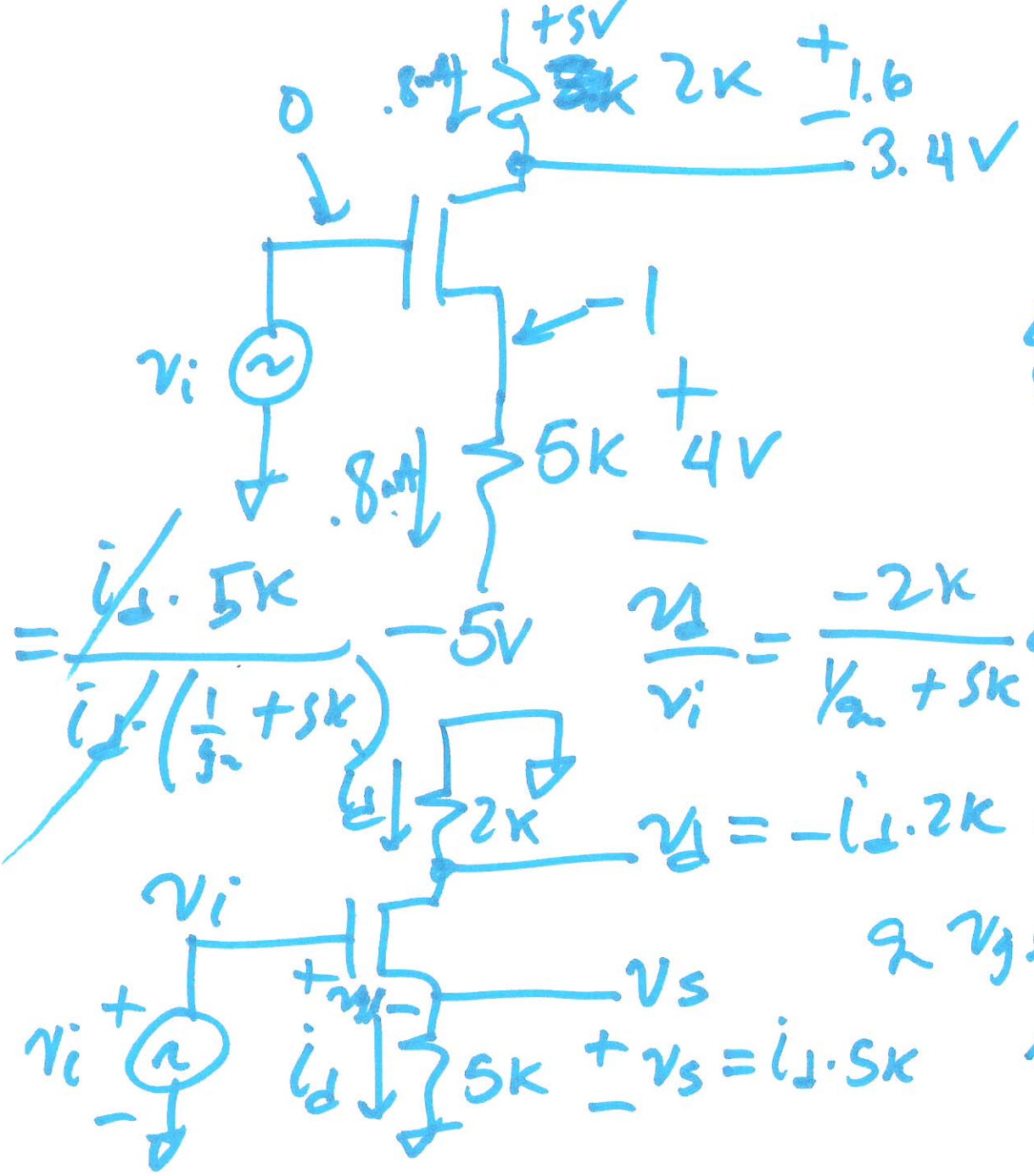
$$I_D^2 - 1.61m I_D + 640N = 0$$

$$I_D = \frac{1.61m \pm \sqrt{(1.61m)^2 - 4(640)N}}{2}$$

$$\boxed{I_D \simeq 0.88 mA}$$

$$I_D = \frac{1.61 \pm 0.179mV}{2}$$

$$\simeq 0.8 mA$$



$$\frac{v_s}{v_i} = \frac{i_d \cdot 5k}{i_d\left(\frac{1}{g_m} + 5k\right)}$$

$$\frac{v_d}{v_i} = \frac{-2k}{1/g_m + 5k}$$

$$v_d = -i_d \cdot 2k$$

$$v_i = v_{gs} + v_s$$

$$= i_d\left(\frac{1}{g_m} + 5k\right)$$

$$g_m = \sqrt{2K_p \frac{W}{L} I_D}$$

$$= \sqrt{2\beta I_D}$$

$$g_m = \sqrt{2 \cdot 100\mu \cdot \frac{100}{1} \cdot 1mA}$$

$$= 4.5 \frac{mA}{V}$$

$$g_m = 2\beta(V_{GS} - V_{TH})$$

$$\& \; v_{gs} = i_d$$