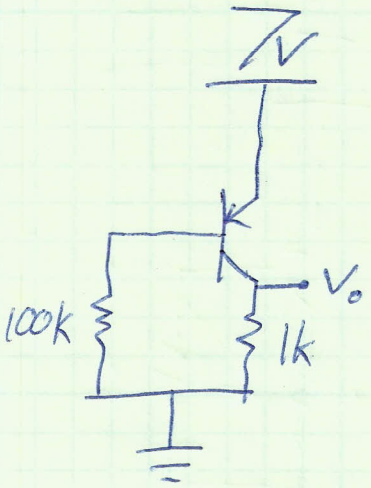
ECE 65 | Quiz 2

Question 1



assume cut-off

$i_B = 0$, $i_C = 0$

$V_{EB} = 7V > V_{D0}$

→ not cut-off

assume active linear

$7V - 0.7V - 100k \cdot i_B = 0$

$i_B = \frac{6.3V}{100k} = 63\mu A$

$i_C = \beta i_B = 200 \times 63\mu A = 12.6mA$

$7V - V_{EC} - 1k \times 12.6mA = 0$

$V_{EC} = 7 - 12.6 = -5.6V < V_{D0}$

→ not active linear

assume saturation

$V_{EC} = 0.2V$

$7V - 0.2V - 1k \cdot i_C = 0$

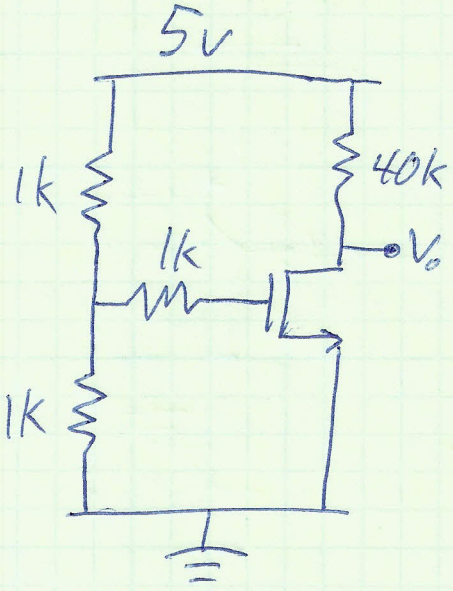
$i_C = \frac{6.8V}{1k} = 6.8mA$

$\frac{i_C}{i_B} = \frac{6.8mA}{63\mu A} = 108 < \beta$

saturation mode with $V_o = 6.8V$

ECE 65 | Quiz 2

Question 2



note: $i_G = 0$ always
- no current through center resistor

$V_{GS} = 2.5v > V_T$

→ not in cut-off

assume saturation

$$i_D = \frac{1}{2} k_n' \frac{W}{L} (V_{GS} - V_T)^2$$

$$= \frac{1}{2} (0.5\,mA/V^2)(2.5v - 2v)^2$$

$$= 62.5\,\mu A$$

$$V_{DS} = 5v - 40k \times 62.5\,\mu A$$

$$= 5v - 2.5v$$

$$= 2.5v$$

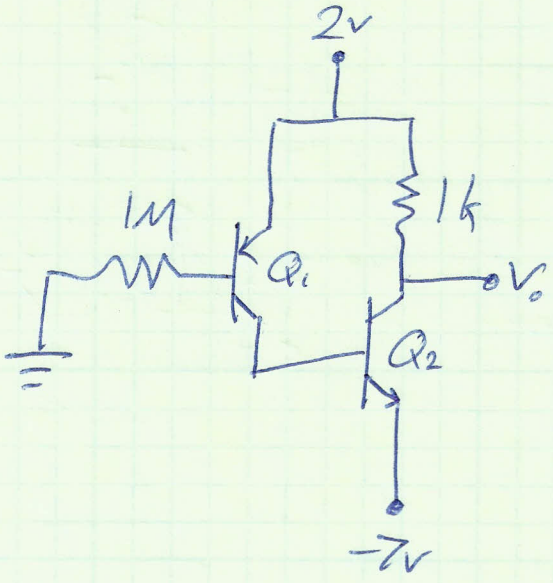
is $V_{DS} > V_{GS} - V_T$?

$2.5v > 2.5v - 2v$ yes

Saturation mode with $V_o = 2.5v$

ECE 65 | Quiz 2

Question 3



assume Q_1 in cut-off

$V_{EB} = 2v > V_{Do}$

→ not cut-off

assume Q_1 in active linear mode

$$i_{B1} = \frac{2 - 0.7}{1M} = 1.3\mu A$$

$$i_{C1} = \beta i_{B1} = 65\mu A$$

assume Q_2 also in active mode

$$i_{B2} = i_{C1} = 65\mu A$$

$$i_{C2} = \beta i_{B2} = 3.3mA$$

$$2v - 1k \cdot 3.3mA - V_{CE} + 7v = 0$$

$$V_{CE} = 9v - 3.3v = 5.7v > V_{Do}$$

so Q_2 is in active mode

for Q_1 $V_{EC} = 9v - 0.7v = 8.3v > V_{Do}$

so Q_1 is in active mode

$$V_o = -7v + V_{EE2}$$

$$= -7v + 5.7v$$

$$V_o = -1.3v$$