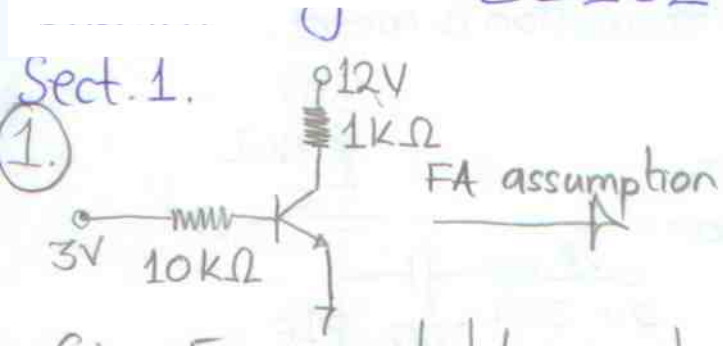
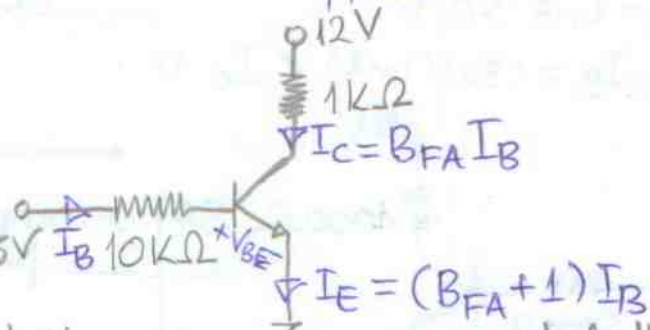
EE282 - Homework #2

Sect. 1.

(1.)





Since E is connected to ground, and $V_{BE} = V_{BE(ON)} = 0,7V$, it follows

$I_B = \frac{3V - 0,7V}{10K\Omega} = 0,23mA$ since $V_B = 0,7V$

$I_C = B_{FA} I_B = 50 \cdot 0,23 = 11,5mA$

$V_C = 12V - (1K\Omega)(11,5mA) = 0,5V$

$V_{BC} = V_B - V_C = 0,7V - 0,5V = 0,2V$

$I_E = (B_{FA}+1) I_B$
$= 51 \cdot (0,23mA)$
$= 11,73mA$

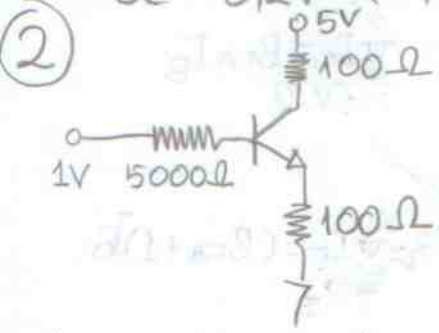
$V_{CE} = V_C - V_E = 0,5V - 0V$
$= 0,5V$

Check FA Conditions:

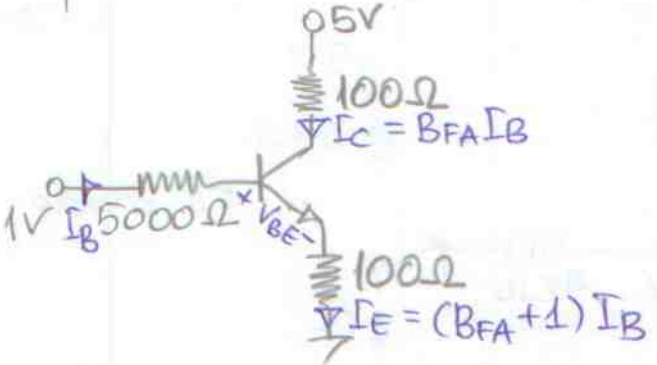
1. $I_B = 0,23mA > 0$ ✓
2. $V_{BC} = 0,2V < 0,7V$ ✓

∴ Assumption is correct, FA mode

(2)



FA assumption



$V_B = 1V - (5000\Omega) I_B$

$V_C = 5V - 5000 I_B$

$V_E = 51 \cdot (100\Omega) I_B = 5100 I_B$

$V_{BC} = 1 - 5000 I_B - 5 + 5000 I_B = -4V$

$V_{BE} = 0,7V$

$V_B - V_E = 1 - 5000 I_B - 5100 I_B = 0,7V$

$= 10100 I_B = 0,3$

$I_B = 0,029mA$

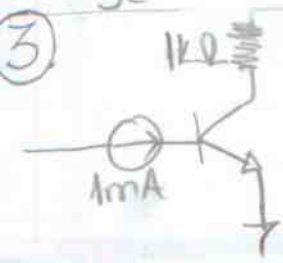
$V_{CE} = V_C - V_E = 5V - 5000 I_B - 5100 I_B = 5V - 100(0,029mA)$
$= 2,1V$

Check FA conditions.

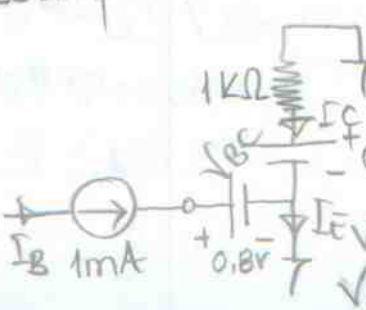
1. $I_B = 0,029mA > 0$ ✓
2. $V_{BC} = -4V < 0,7V$ ✓

→ Assumption is correct

(3)



SAT assumption



$I_B = 1mA$

$I_C = \frac{0,2V - 0V}{1K\Omega}$

$= 0,2mA$

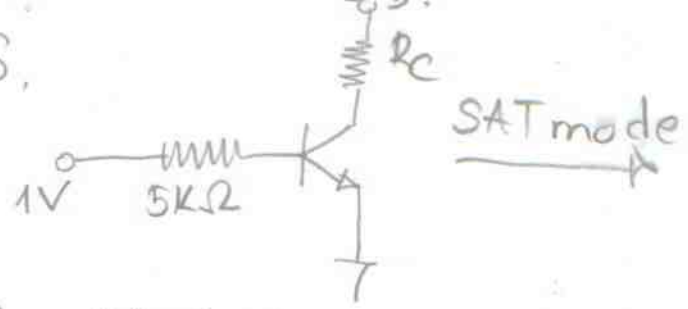
$V_{BE} = 0,8V$

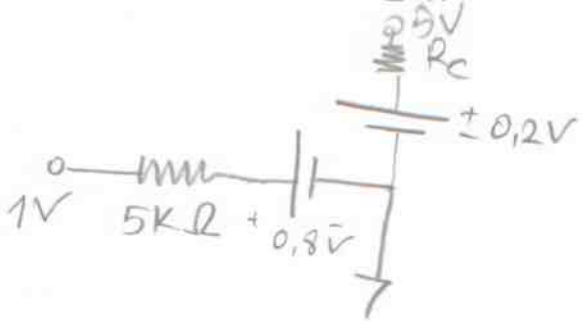
$V_{CE} = 0,2V$

$V_{BC} = 0,6V$

$I_E = I_B + I_C$
$= 0,8mA$

6.





$$I_B = \frac{1V - 0,8V}{5k\Omega} = 0,04mA$$

$$I_C = \frac{5V - 0,2V}{R_C} = \frac{4,8V}{R_C}$$

Condition for SAT

$$B_{FA} I_B = 50\,(0,04\,mA) = 2 > \frac{4,8V}{R_C}$$

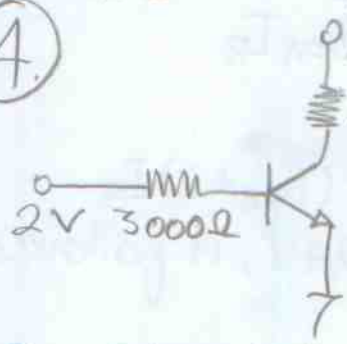
$$\boxed{R_C \geq 2,4k\Omega}$$

Check SAT Conditions:

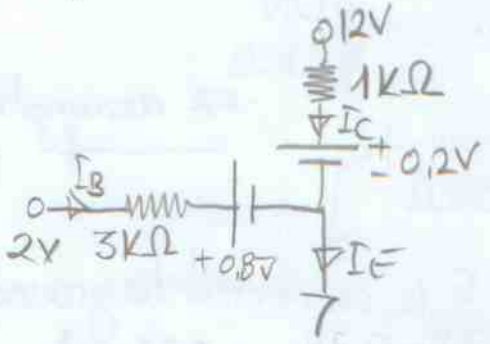
1. $I_B = 1mA > 0$ V
2. $B_{FA} I_B = (50)(1mA) < I_C$ V

→ Assumption is correct.

(4.)



SAT assumption →



$I_B = \frac{2V - 0,8V}{3k\Omega} = 0,4mA$

$I_C = \frac{12V - 0,2V}{1k\Omega} = 11,8mA$

$I_E = I_B + I_C = 12,2mA$

$V_{BE} = 0,8$ V

$V_{CE} = 0,2$ V

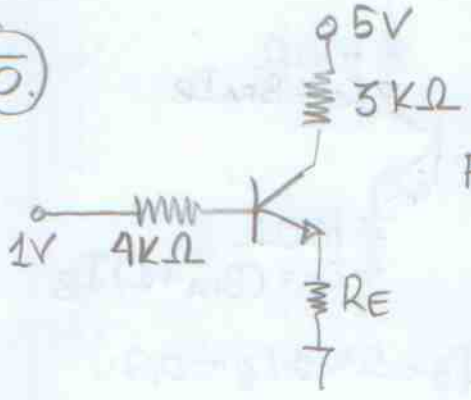
$V_{BC} = 0,6$ V

Check SAT Conditions:

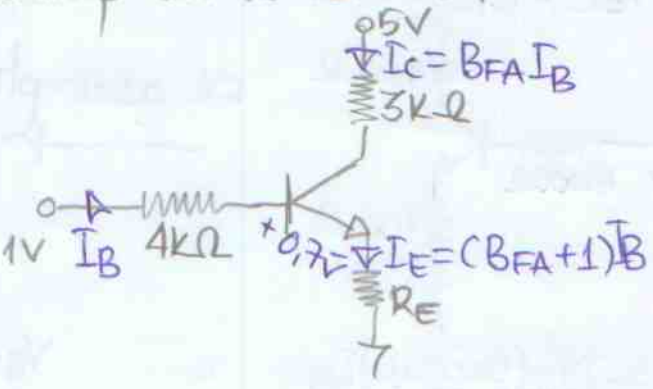
1. $I_B = 0,4mA > 0$ V
2. $B_{FA} I_B = 50(0,4mA) = 20mA > I_C$ V

→ Assumption is correct.

(5.)



FA mode →



$V_B = 1 - (4k\Omega) I_B$

$V_C = 5 - (3k\Omega) I_B (50)$

$V_E = 51 I_B \cdot R_E$

$V_{BC} < 0,7$

$V_{BC} = 1 - 4000 I_B - 5 + 15000 I_B$

$= -4 + 146000 I_B < 0,7$

$V_{BE} = V_B - V_E = 0,7$V

$1 - 4000 I_B - 51 R_E I_B = 0,7$V

$0,3 = I_B (4000 + 51 R_E)$

$I_B = \frac{0,3}{4000 + 51 R_E} > 0$

$-4 + 146000 \left(\frac{0,3}{4000 + 51 R_E}\right) < 0,7$

$R_E > 101,2\Omega$