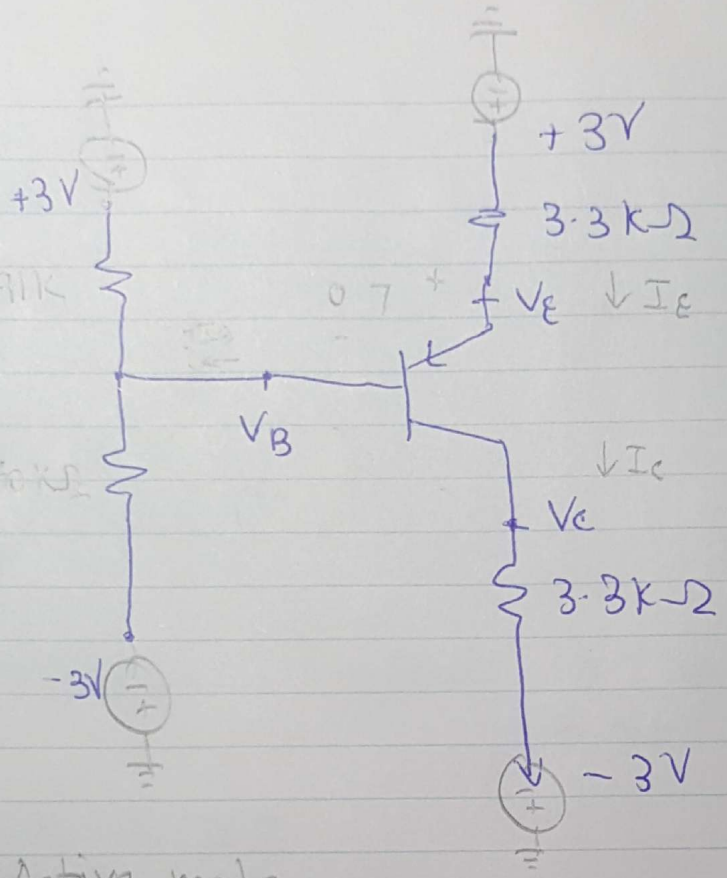

1) Active mode

$I_E = (\beta+1) I_B$

$I_C = \beta I_B$

KVL at BE loop

↳ $-3V + 3.3K \cdot I_E + 0.7 + 91K \cdot \frac{I_E}{\beta+1} + 3V = 0$

↳ $-0.7 = 3.3K(I_E) + 91K \cdot \frac{1}{\beta+1} (I_E)$

↳ $-0.7 = I_E \left[3.3K + 91K \cdot \frac{1}{101} \right]$

$-0.7 = I_E (4201)$

• $I_E = -0.167$ mA

$V_E = 3 - 3.3K(I_E)$

$= 3 - 3.3K(-0.167mA)$

$V_E = 3.55V$

$V_B = V_E - 0.7$

$V_B = 2.85V$

• $I_B = \frac{I_E}{101} = -0.00167$ mA

• $I_C = 100 (-0.00167mA)$

$= -0.167$ mA

$V_C = -3 - 3.3K(I_C)$

$V_C = -2.45V$

Active mode as $V_C < V_B$

Part 2

1) Edge between active and saturation

↳ $V_B = V_C$

$V_E - 0.7 = V_C \rightarrow 3 - R_E I_E - 0.7 = -3 - R_C (I_C)$

KVL on right loop

↳ $3V - I_C(R_C) - 0.7 - I_E(R_E) + 3V = 0$

$5.3V = 100 I_B (R_C) + 101 I_B (R_E)$

$100 I_B \simeq 101 I_B$

$5.3 = 100 I_B (R_C + R_E)$

↳ $0.053 = I_B (R_C + R_E) \rightarrow$ eqv 1

From KCL on left branch

↳ $I_B + \frac{3}{91K} + \frac{-3}{150K} = 0$

↳ $I_B = -0.013\ mA$

eqv 2 $\rightarrow 4077\ \Omega = R_C + R_E$

KVL at top loop

↳ $-3 + R_E \cdot (101 I_B) + 0.7 + (I_B) 91K + 3 = 0$

$-0.7 = I_B (R_E \cdot (101) + 91K)$

where $I_B = -0.013\ mA$

↳ $53846 = 101 R_E + 91K$

$\boxed{R_E = 368\ \Omega}$

$R_C = 4077 - 368\ \Omega \rightarrow \boxed{R_C = 3.7\ k}$