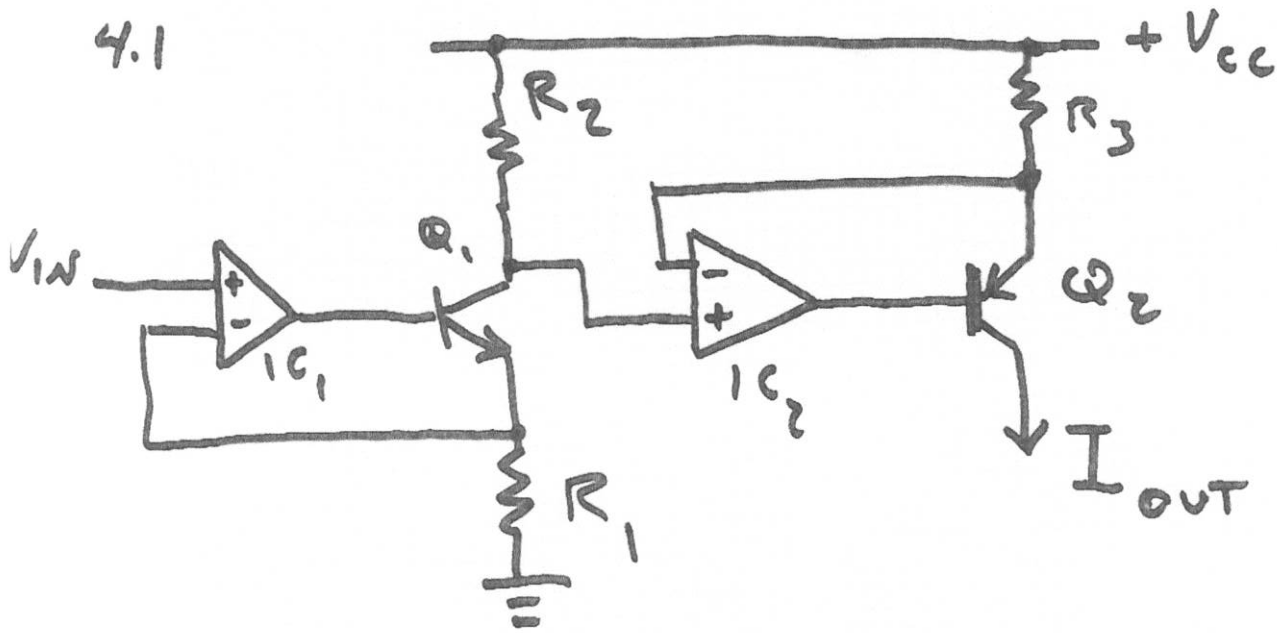


4.1



NOTE: BOTH OP-AMPS HAVE NEG. FEEDBACK

$$I_{OUT} = \frac{V_{CC} - V_{E, Q2}}{R_3}$$

Now, $V_{E, Q2} = V_{IC2}^+ = V_{C, Q1}$ (NEG. FEEDBACK)

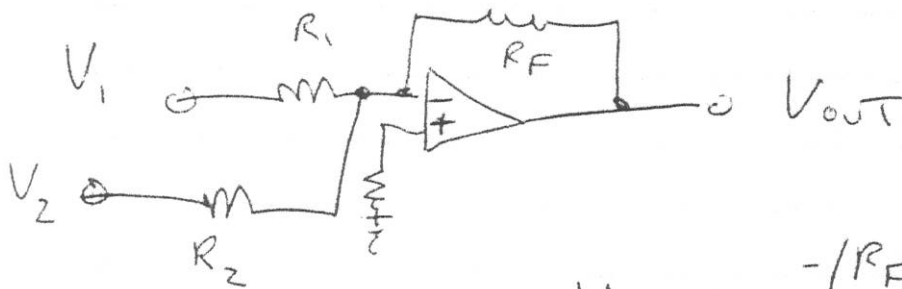
$$V_{C, Q1} = V_{CC} - I_{C, Q1} \cdot R_2$$

BUT, $I_{C, Q1} \approx I_{E, Q1} = \frac{V_{IN}}{R_1}$

$$\Rightarrow V_{C, Q1} = V_{CC} - V_{IN} \frac{R_2}{R_1}$$

so, $I = \frac{V_{CC} - (V_{CC} - V_{IN} \frac{R_2}{R_1})}{R_3} = + \frac{V_{IN} R_2}{R_1 R_3}$

#2 APPLICATION OF SUMMING AMPS



$$V_{out} = -\left(\frac{R_F}{R_1}\right)V_1 - \left(\frac{R_F}{R_2}\right)V_2$$

FROM CIRCUIT SKETCH

FROM CIRCUIT SKETCH

$$X = -(-C_1 \times 100) \frac{R}{R} - b_1 y \frac{R}{R}$$

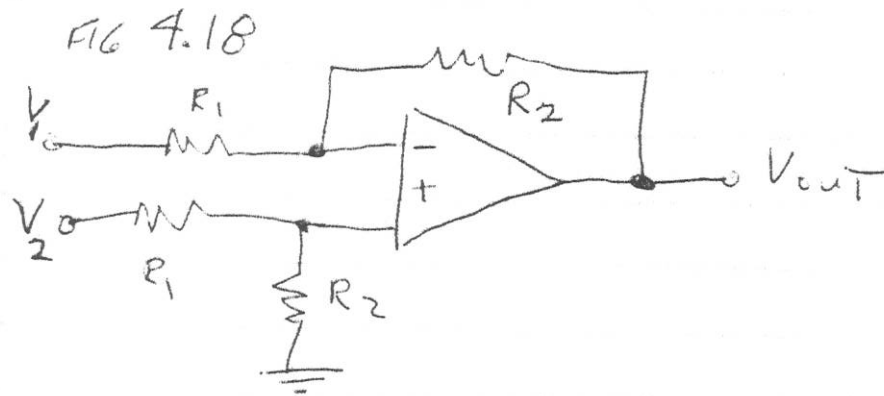
$$= +100C_1 - b_1 y \quad (1)$$

$$y = -(C_2 \times 100) \frac{R}{R} - a_2 X \quad (2)$$

$$a_2 X + y = -100C_2 \quad (3)$$

$$(1) \Rightarrow X + b_1 y = 100C_1$$

$$(3) \Rightarrow a_2 X + y = -100C_2$$



NEGATIVE FEEDBACK $\Rightarrow V_- = V_+ = \left(\frac{R_2}{R_1 + R_2} \right) V_2$

NOW, $V_- = V_1 - i R_1$

w/ $i = (V_1 - V_{out}) / (R_1 + R_2)$

$$V_- = V_1 - \left(\frac{V_1 - V_{out}}{R_1 + R_2} \right) R_1$$

$$\left(\frac{R_2}{R_1 + R_2} \right) V_2 = V_1 - \left(\frac{V_1 - V_{out}}{R_1 + R_2} \right) R_1$$

$$V_2 R_2 = (R_1 + R_2) V_1 - (V_1 - V_{out}) R_1$$

$$V_2 \left(\frac{R_2}{R_1} \right) = \left(\frac{R_1 + R_2}{R_1} \right) V_1 - V_1 + V_{out}$$

$$\Rightarrow \boxed{V_{out} = \left(\frac{R_2}{R_1} \right) (V_2 - V_1)}$$