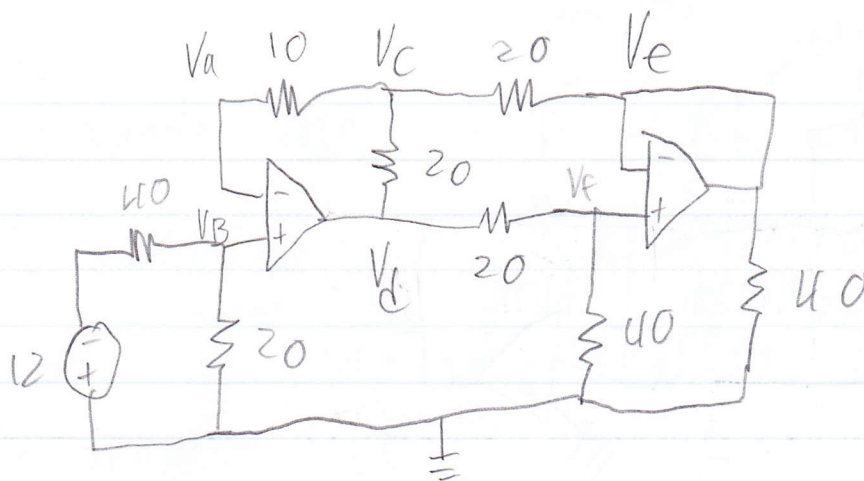


S3



$$V_e = V_f$$

$$V_a = 11$$

$$V_b = -4$$

V_a
 V_c
 V_d
 V_f
 OPA
 OPB

$$\begin{aligned} \frac{1}{10} V_a - \frac{1}{10} V_c &= 0 \\ -\frac{1}{10} V_a + \left(\frac{1}{10} + \frac{1}{20} + \frac{1}{20}\right) V_c - \frac{1}{20} V_d - \frac{1}{20} V_e &= 0 \\ -\frac{1}{20} V_d + \left(\frac{1}{20} + \frac{1}{40}\right) V_f &= 0 \\ V_a &= -4 \\ V_e - V_f &= 0 \end{aligned}$$

$$\begin{bmatrix} V_a & V_c & V_d & V_e & V_f \\ \frac{1}{10} & -\frac{1}{10} & 0 & 0 & 0 \\ -\frac{1}{10} & \frac{1}{10} + \frac{1}{20} + \frac{1}{20} & -\frac{1}{20} & -\frac{1}{20} & 0 \\ 0 & 0 & -\frac{1}{20} & 0 & \frac{1}{20} + \frac{1}{40} \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -1 \end{bmatrix}^{-1} \begin{bmatrix} 0 \\ 0 \\ 0 \\ -4 \\ 0 \end{bmatrix} = \begin{bmatrix} -4 \\ -4 \\ -4.8 \\ -3.2 \\ -3.2 \end{bmatrix} \begin{matrix} V_a \\ V_c \\ V_d \\ V_e \\ V_f \end{matrix}$$

$$\frac{V_d - V_f}{20} = \frac{-4.8 - (-3.2)}{20} = -0.08 \text{ mA}$$