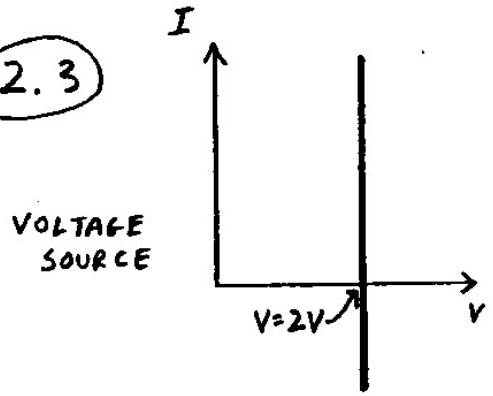
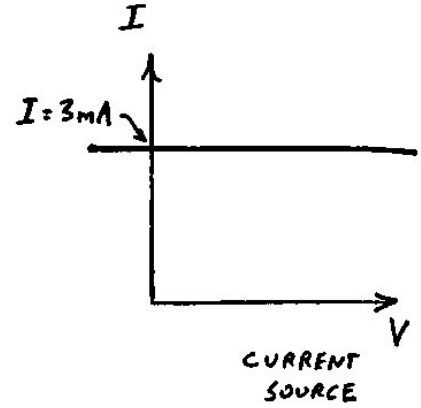
EECS 100 Spring 2003 Problem Set #1 Solution

(1.3) FROM KIRCHHOFF'S CURRENT LAW, THE SUM OF THE CURRENTS <u>ENTERING</u> NODE X MUST BE ZERO. HENCE $I_1 + I_2 = 0$. THUS $I_2 = -I_1 = -2$ mA.

(2.3)





NOTE THAT, FOR EXAMPLE, THE VOLTAGE ACROSS THE IDEAL VOLTAGE SOURCE SIMPLY DOESN'T <u>CARE</u> WHAT THE CURRENT IS; THE VOLTAGE ACROSS IT IS <u>ALWAYS</u> 2V. THAT IS THE DISTINCTIVE PROPERTY OF THIS CIRCUIT ELEMENT.

(2.11) $$R = \frac{R_1 R_3}{R_1 + R_3} + \frac{R_2 R_4}{R_2 + R_4} = 5.064\ k\Omega$$

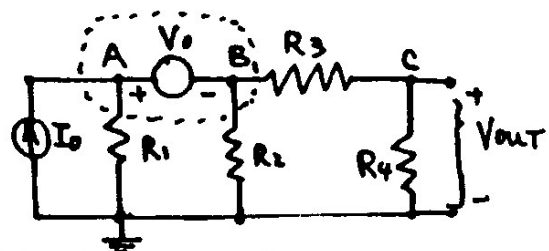
(2.19) CALL THE VOLTAGE AT THE TOP OF $R_1 = V_1$, LET BOTTOM OF CIRCUIT BE GROUND. THEN

$$I_0 - \frac{V_1}{R_1} - \frac{V_1 - V_0}{R_3} = 0$$

$$\therefore \quad V_1 = \frac{R_1 (I_0 R_3 + V_0)}{R_1 + R_3}$$

$$I_1 = \frac{V_1 - V_0}{R_3} = \frac{I_0 R_1 - V_0}{R_1 + R_3} = 0$$

(2.23) (1)



SINCE WE HAVE A VOLTAGE SOURCE AS A BRANCH, WE MERGE NODE A & B FOR THE PURPOSE OF WRITING KCL EQUATIONS.

$$V_A = V_B + V_0 \qquad \text{— (a)}$$

KCL AT A&B $$I_0 - \frac{V_A}{R_1} - \frac{V_B}{R_2} + \frac{V_C - V_B}{R_3} = 0 \qquad \text{— (b)}$$

KCL AT C $\quad \dfrac{V_B - V_C}{R_3} - \dfrac{V_C}{R_4} = 0 \quad$ ——— (c)

ONLY THREE EQUATIONS ARE NECESSARY.

(2) SOLVING THE EQUATIONS GIVES

$$V_B = \frac{R_2(R_3+R_4)(I_0R_1 - V_0)}{(R_1+R_2)(R_3+R_4)+R_1R_2}$$

$$V_C = \frac{R_4}{R_3+R_4} \cdot V_B$$

$$= \frac{R_2R_4(I_0R_1 - V_0)}{(R_1+R_2)(R_3+R_4)+R_1R_2}$$

$$V_A = V_B + V_0$$

$$= \frac{R_1(R_3+R_4)(V_0 + I_0R_2) + R_1R_2V_0}{(R_1+R_2)(R_3+R_4)+R_1R_2}$$

$$V_{OUT} = V_C$$