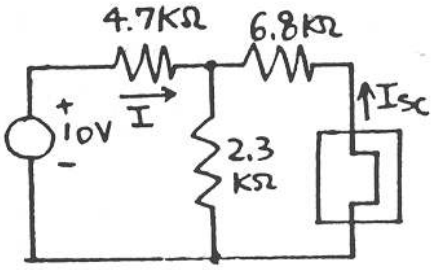
EECS 100 Spring 2003 Problem Set #2 Solution

(3.5) $I = \dfrac{10}{4.7K + 6.8K // 2.3K}$

$= 1.558 \text{ mA}$



BY CURRENT DIVIDER RULE,

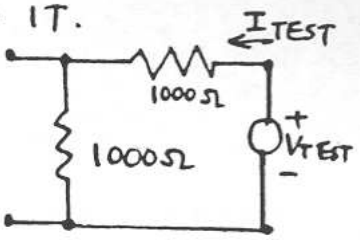
$$I_{SC} = -\frac{2.3K}{6.8K + 2.3K} \cdot 1.558 \text{ mA}$$

$$= \underline{\underline{-0.394 \text{ mA}}}$$

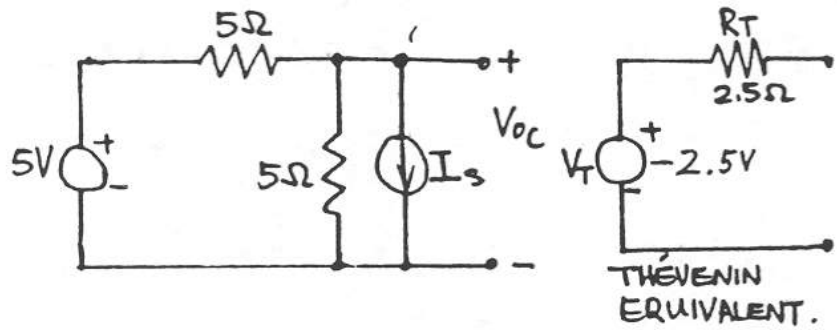
(3.11) SETTING THE CURRENT SOURCE TO ZERO MEANS OPEN-CIRCUITING IT.

$\therefore \; R_T = (1000 + 1000)\Omega$

$= \underline{\underline{2 K\Omega}}$



(3.12)



TO DETERMINE R_T, REPLACE THE VOLTAGE SOURCE BY A SHORT CIRCUIT AND THE CURRENT SOURCE BY AN OPEN CIRCUIT. THEN $R_T = 5\Omega \| 5\Omega = \underline{2.5\Omega}$

TO DETERMINE V_{oc}, WRITE A NODE EQUATION FOR THE OUTPUT NODE:

$$\frac{V_{oc} - 5V}{5\Omega} + \frac{V_{oc}}{5\Omega} + I_s = 0 \quad \text{OR} \quad V_{oc} = \frac{5(1-I_s)}{2}$$

FOR $I_s = 2A$, $V_T = V_{oc} = \frac{5(1-2)}{2} = \underline{\underline{-2.5V}}$

THEN THE THÉVENIN EQUIVALENT IS SHOWN ABOVE. ■

(3.13) SEE SOLUTION TO PROB. 3.12.

FOR $I_s = 1A$, $V_T = V_{oc} = 0$

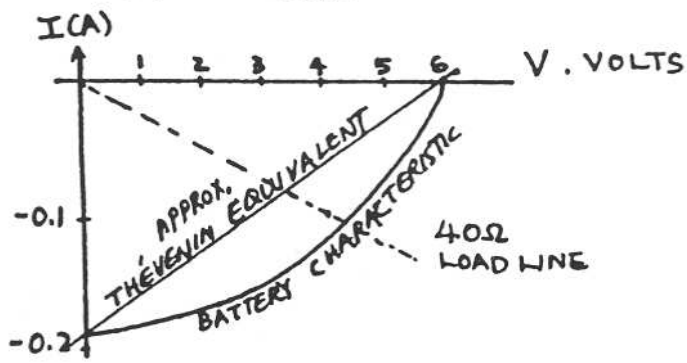
THE THÉVENIN EQUIVALENT IS SIMPLY A 2.5 Ω RESISTOR. NOTE THAT THE FORMULA $R_T = -V_{oc}/I_{sc}$ cannot be used since $V_T = 0V$ yields $R_T = 0$ ohm, which is incorrect.

3.15 AN IDEAL , VOLTMETER (AMMETER) IS AN OPEN (SHORT) CIRCUIT. THUS FROM FIG 3.38, $V_{oc} = 6V$ AND $I_{sc} = -0.19A$. IT FOLLOWS THAT THE CORRESPONDING THÉVENIN EQUIVALENT CIRCUIT IS CHARACTERIZED BY $V_T = V_{oc} = 6V$,

$$R_T = -\frac{V_{oc}}{I_{sc}} = -\frac{6V}{-0.19A} \approx 33\Omega$$

AN I-V CHARACTERISTIC GIVEN BY BY EQ. (3-1)

$$I = \frac{V}{R_T} - \frac{V_T}{R_T} = \frac{1}{33\Omega}V \quad 0.19A.$$



THE TWO CHARACTERISTICS SHOWN DO NOT AGREE BECAUSE THE BATTERY IS NON-LINEAR AND HENCE HAS NO THÉVENIN EQUIVALENT, A THÉVENIN CIRCUIT IS ALWAYS REPRESENTED BY A LINEAR I-V CHARACTERISITIC. ■

(3.31) WHEN $V_T = 5V$, $V \cong 2.6V$, $I \cong 2.2mA$ ACROSS N_1 i.e. $P = 2.6 \times 2.2\,mW \cong 5.72\,mW$

THEREFORE FROM (3) OF PROBLEM 3.29.

P_{AV} ENTERING N_1 = INSTANTANEOUS POWER × DUTY CYCLE

$= 5.72 \times 25\%\ mW$

$= \underline{\underline{1.43\ mW}}$ ∎