Spring 2008

EECS70A / CSE 70A Network Analysis I
Prof. Peter Burke

Midterm I solution

Grading criteria for all questions: no credits for answers without units and - 5pts for each wrong unit.

Problem 1:

(a) $i = \frac{100A \cdot h}{50} = \underline{2\ A}$

(b) $t = \frac{100Ah}{0.001A} = \frac{100{,}000h}{24h/day} = \underline{4{,}167\ days}$

Grading criteria: 3pts for each correct charge and time equation
4pts for each wrong unit conversion with correct steps

Problem 2:

Using voltage division,

$$V_0 = \frac{5\Omega}{(15+5)\Omega}(20V) = 5V$$

Alternatively,

$$I_0 = \frac{20V}{20\Omega} = 1A \quad V_0 = 1A \cdot 5\Omega = 5V$$

Grading criteria: 2pts for only Ohm's Law
5pts for correct voltage division equation or equation for current I_0
7.5pts for correct answer with wrong sign

Problem 3:

Applying KVL,

$$-10 + 10 + 20I - 20 = 0, \qquad I = 1A$$

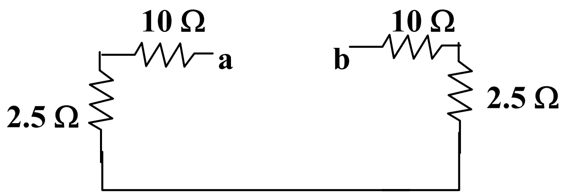
$$R = \frac{V}{I} = \frac{10}{1} = 10\Omega$$

Grading criteria: 2pts for only Ohm's law
5pts for only correct KVL with wrong current I
10pts for KVL equation with correct current I
15pts for correct current I with wrong resistance R

Problem 4:

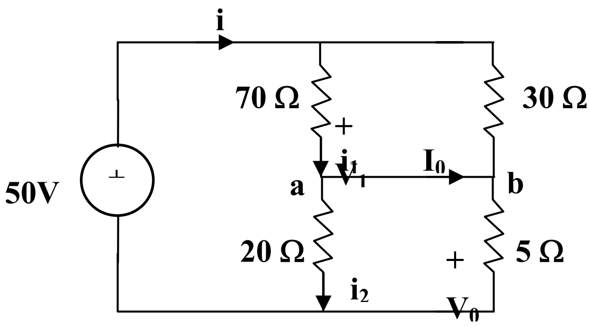
$5\|5 = 2.5\Omega$ $5\|5 = 2.5\Omega$

R_{ab} = 10 + 2.5 + 2.5 + 10 = **25 Ω**



Grading criteria: 3pts for any correct parallel and series calculations or Delta,Y conversion
5pts for only showing both 5Ω//5Ω configurations
7pts for only showing correct rearrangement of resistances
10pts for wrong final answer with correct steps

Problem 5:



Combining the versions in parallel,

$$70\|30 = \frac{70x30}{100} = 21\Omega \quad , 20\|5 = \frac{20x5}{25} = 4\ \Omega$$

$$i = \frac{50}{21+4} = 2\ A$$

$v_i = 21i = 42$ V, $v_0 = 4i = 8$ V

$$i_1 = \frac{v_1}{70} = 0.6\ A,\ i_2 = \frac{v_2}{20} = 0.4\ A$$

At node a, KCL must be satisfied

$i_1 = i_2 + I_0$ $\qquad$ $0.6 = 0.4 + I_0$ $\qquad$ $I_0 = 0.2$ A

Hence $v_0 =$ **8 V** and $I_0 =$ **0.2A**

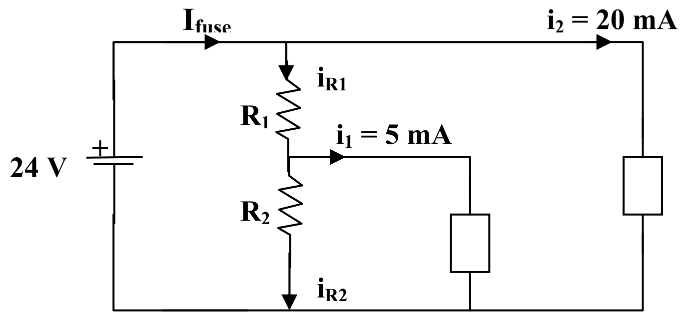
Grading criteria: 5pts for only correct KCL, KVL equation or correct simplification
7pts for wrong I_0 with correct i_1 and i_2 using correct KCL equation
7pts for wrong V_0 with correct KVL equation
10pts for only correct V_0 with correct simplification steps

Problem 6:

The voltage across the fuse should be negligible when compared with 24 V.

$$I_1 = \frac{p_1}{V_1} = \frac{45mW}{9V} = 5mA$$

$$I_2 = \frac{p_2}{V_2} = \frac{480mW}{24} = 20mA$$



Let R_3 represent the resistance of the first device.

$$R_3 = 9/0.005 = 1{,}800\ \Omega$$

The fuse condition (60 mA, 2 Ω) is not a fixed condition, but is the maximum condition. The voltage across R_3 must equal 9 volts. Since the circuit is powered by a battery we could choose the value of R_2 which draws the least current, **$R_2 = \infty$**. Thus we can calculate the value of R_1 that give 9 volts across R_3.

$$9 = (1800/(R_1 + 1800))24 \text{ or } R_1 = (24/9)1800 - 1800 = \mathbf{3{,}000\Omega}$$

This value of R_1 means that we only have a total of 25 mA flowing out of the battery through the fuse.

Grading criteria: 5pts for only correct power equation

7pts for each answer of R_1=375 Ω, R_2=257 Ω with correct i_1

10pts for correct i_1(device 1) with correct power equation

12pts for correct i_1 and correct i_{R1}=40mA and i_{R2}=35mA

15pts for correct i_1 and one correct R_1=3 K Ω or $R_2=\infty\Omega$