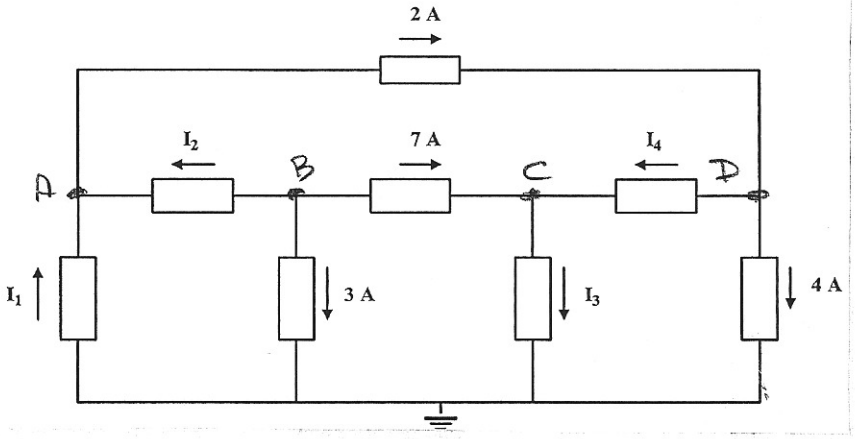
ECE 301
Fall Semester
HW #1 Solutions

wkg

(1)

(1) For the circuit shown in Figure 1, find the currents I_1, I_2, I_3, and I_4.
Answers: $I_1 = 12A$, $I_3 = 5$ A (Answers for I_2 and I_4 on your own)



At D:

$$I_4 + 4 - 2 = 0$$

$$\boxed{I_4 = -2A}$$

At C:

$$I_3 = 7 + I_4 = 7 - 2 = 5A$$

$$\boxed{I_3 = 5A}$$

At B

$$I_2 = -3 - 7 = -10\,A$$

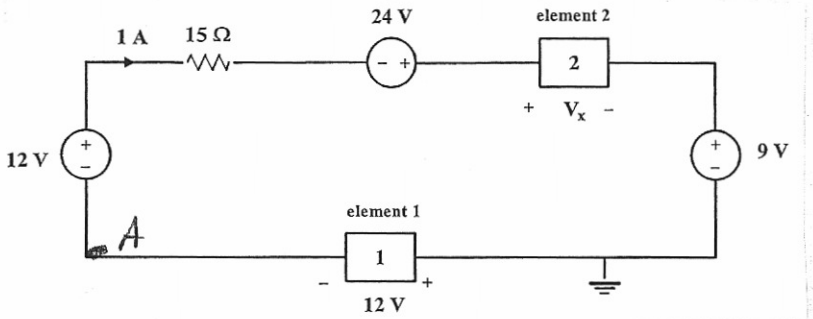
$$\boxed{I_2 = -10\,A}$$

At A

$$I_1 = 2 - I_2$$

$$\boxed{I_1 = 12A}$$

(2)



Find V_x

using KVL, starting at A, going CW,
using Σ drops = 0

$$-12 + (1)(15) - 24 + V_x + 9 + 12 = 0$$

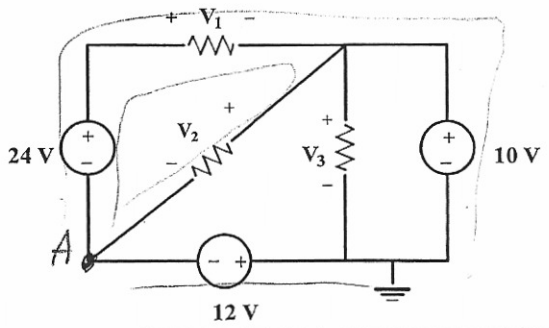
$$V_x = 12 - 15 + 24 - 21$$

$$= 36 - 36 = 0$$

$$\boxed{V_x = 0 \text{ V}}$$

(3)

(3) You are given the circuit shown in Figure 3. Find the voltages V_1, V_2 and V_3. Answers on your own.



Starting at A, going cw, use Σ Drops = 0

$-24 + V_1 + 10 + 12 = 0$

$V_1 = 24 - 22 = 2\ V$

$\boxed{V_1 = 2\ V}$

Start at A, cw, Σ Drops = 0

$-24 + V_1 + V_2 = 0$

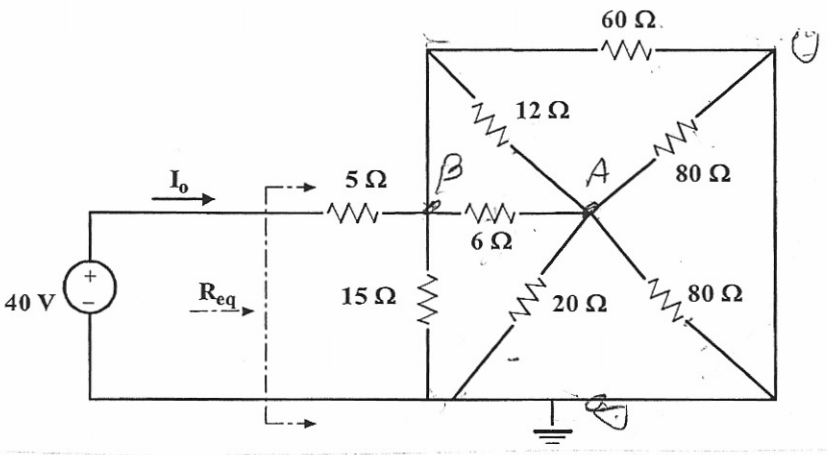
$V_2 = 24 - V_1 = 24 - 2$

$\boxed{V_2 = 22\ V}$

By inspection;

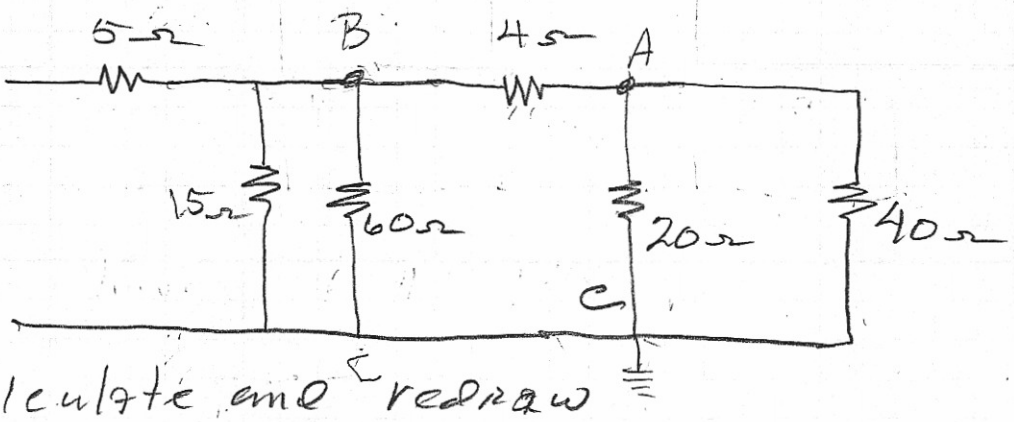
$\boxed{V_3 = 10\ V}$

(4) You are given the circuit shown in Figure 4. Find R_{eq} and I_o. Ans: $R_{eq} = 12.09\ \Omega$, $I_o = 3.309$ A

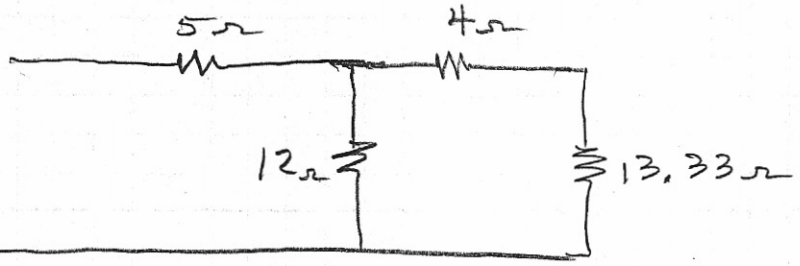


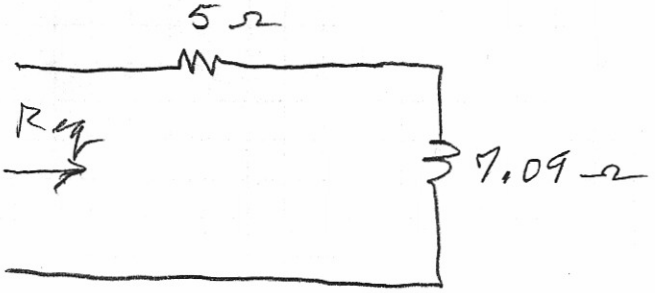
The 6Ω & 12Ω are in parallel 6||12 = 4Ω

Two 80Ω are in parallel. Redraw

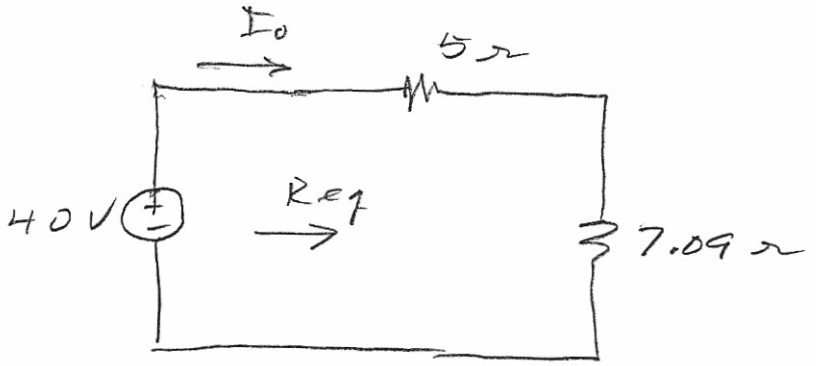


Calculate and redraw





(4) cont.



$$R_{eq} = 5 + 7.09 = 12.09\,\Omega$$

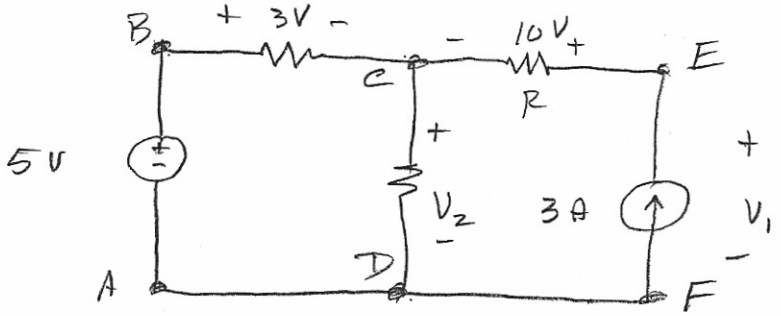
$$\boxed{R_{eq} = 12.09\,\Omega}$$

$$I_o = \frac{40}{12.09}$$

$$\boxed{I_o = 3.309\,A}$$

(5) Prob 2.16 in text.

Use KCL and find V_1 and V_2



Should say KVL

Start at A, go A-B-C-D using Σ drops = 0

$$-5 + 3 + V_2 = 0$$

$$\boxed{V_2 = 2V}$$

Start a D and go D-C-E-F

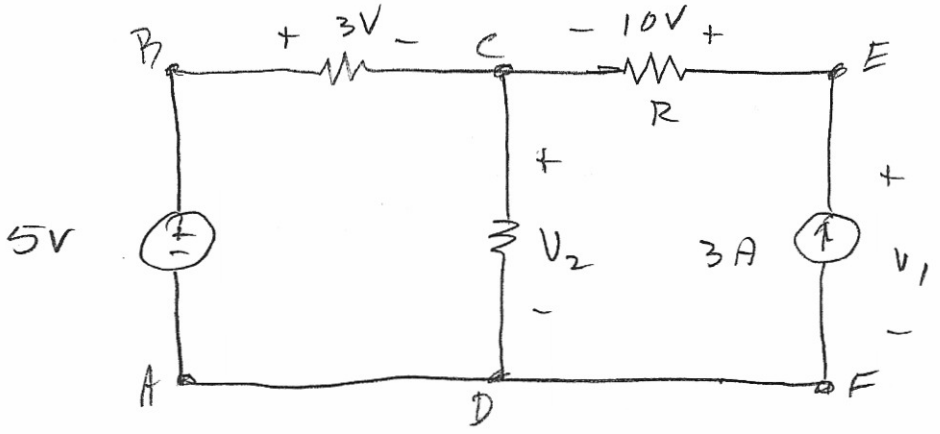
$$-V_2 - 10 + V_1 = 0$$

$$V_1 = 10 + V_2 = 12V$$

$$\boxed{V_1 = 12V}$$

(6) Prob 2.21 text

For the following circuit find the power absorbed by R and power delivered by the current source



Around A-B-C-D we have

$$-5 + 3 + V_2 = 0$$

$$V_2 = 2V$$

Around D-C-E-F we have

$$-V_2 - 10 + V_1 = 0$$

$$V_1 = 10 + V_2 = 10 + 2 = 12V$$

$$V_1 = 12\,V$$

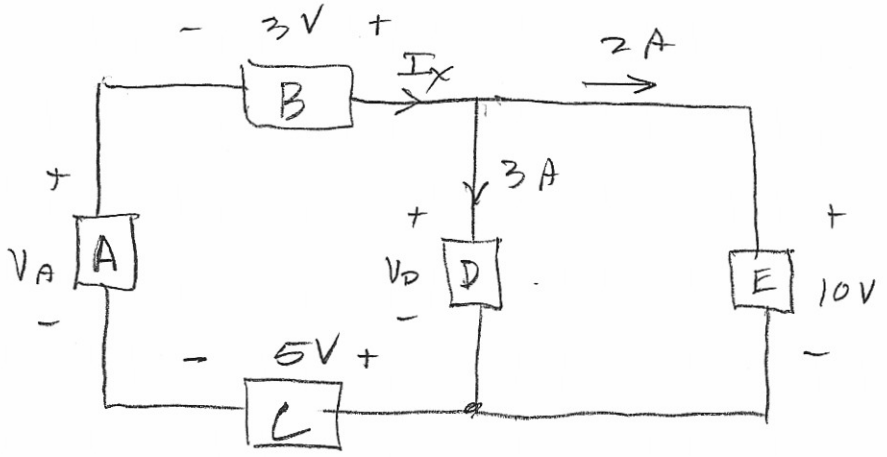
$$P_{ABS_R} = 3 \times 10 = 30\,W$$

$$P_{3A\ SOURCE} = 3 \times V_1 = 3 \times 12 = 36\,W$$

(7) Prob 2.22 text. For the following ckt;

(a) Find which components are absorbing power.

(b) Is conservation of power satisfied? Explain



$I_x = 5A$

By inspection, $V_D = 10V$

$-V_A - 3 + 10 + 5 = 0$

$V_A = 12V$

Assume all are absorbing, adjust

A $\quad P_{ABS_A} = 12(-I_x) = -60W$

B $\quad P_{ABS_B} = -3I_x = -15W$

C $\quad P_{ABS_C} = 5 \times I_x = 25W$

D $\quad P_{ABS_D} = V_D \times 3 = 30W$

(7) cont

$$P_{ABS_E} = 10 \times 2 = 20\ W$$

Elements that absorb power are

C, D, E

Elements supplying

A and B

Check

$$P_{sup} = P_{abs}$$

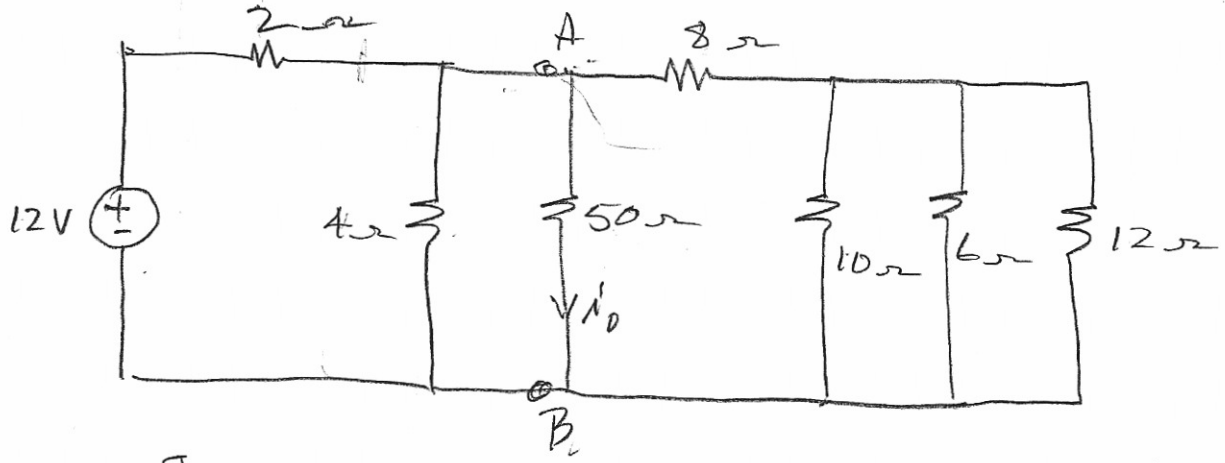
$$P_{sup} \quad\quad P_{ABS}$$
$$+ 40W + 15W \stackrel{?}{=} 25 + 30 + 20$$

$$75\ W = 75\ W$$

Check

18) prob 2.60

For the following circuit, find i and resistance seen by the source



$8\Omega + 10 \| 6 \| 12 = 8 + 4 \| 10 = 10.857$

Then

$4 \| 50 \| 10.857$ ✓ ok

$G = 4^{-1} + 50^{-1} + 10.857^{-1} = .3621$ ✓ ok

$R = 2.762\ \Omega$

$R_{eq} = 2 + 2.762 = 4.76\ \Omega$

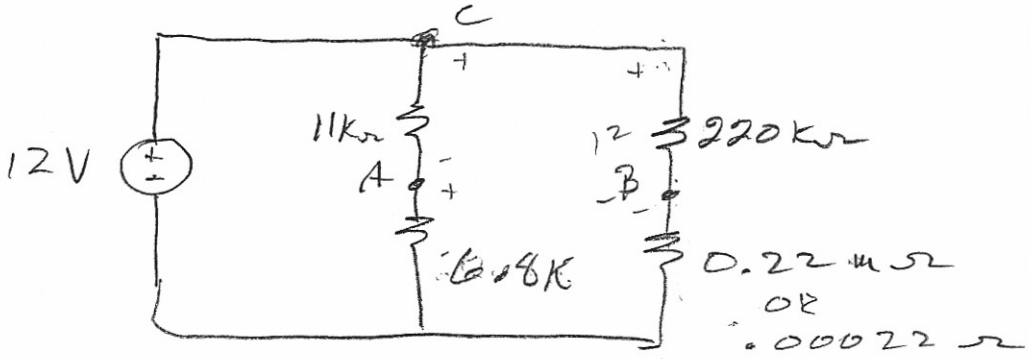
Want i_0: Voltage across AB is

$$V_{AB} = \frac{12 \times 2.76}{2 + 2.76} = 6.958$$

$$i_0 = \frac{V_{AB}}{50} = 0.14\ A = 140\ mA$$

(9) Prob 2.67

For the following circuit determine V_{AB}



$$V_{CA} = \frac{12 \times 11K}{11K + 6.8K} = 7.416 \quad V$$

For all practical purposes, $V_{CB} = 12V$

So,

$$V_{AB} + V_{CA} - V_{CB} = 0$$

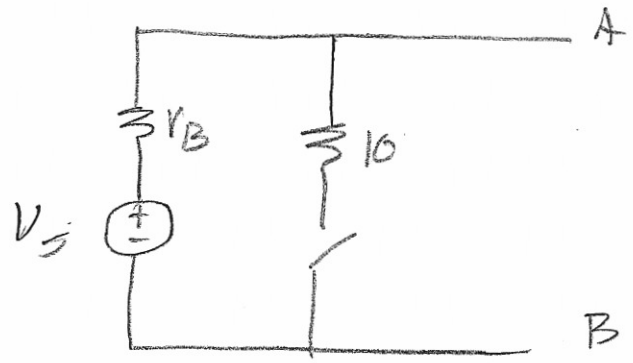
$$V_{AB} = V_{CB} - V_{CA} = 12 - 7.42$$

$$V_{AB} = 4.58\ V$$

(10) 2.72 in the text

Finding r_B (battery resistance)

Assume the following conditions



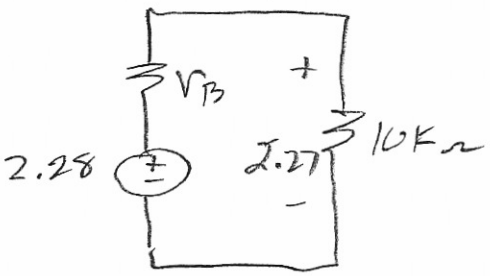
(a)

(i) V_{AB} is 2.28 V when the switch is open.

(ii) V_{AB} is 2.27 V when the switch is closed.

Find r_B.

From (i) we know $V_s = 2.28$



Using Voltage Division

$$2.27 = \frac{2.28 \times 10}{10 + r_B}$$

(10)

$$2.27(10 + r_B) = 2.28 \times 10$$

$$2.27 r_B = (2.28 - 2.27)10$$

$$r_B = \frac{0.1}{2.27}$$

$$r_B = 0.0044\ \Omega$$

(b) Near Infinity

$V_{AB} = 2.2\text{V}$, switch open

$V_{AB} = 0.31\text{ V}$, switch closed

$$.31 = \frac{2.2 \times 10}{r_B + 10}$$

$$.31(r_B + 10) = 2.2 \times 10$$

$$.31 r_B = 2.2 \times 10 - .31 \times 10$$

$$\boxed{R_B = 60.97\ \Omega}$$