EECS 40, Fall 2007
Prof. Chang-Hasnain

Homework #1

Due at 5 pm in 240 Cory on Wednesday, 9/5/07
Total Points: 100

- Put (1) your name and (2) discussion section number on your homework.
- You need to put down all the derivation steps to obtain full credits of the problems. Numerical answers alone will at best receive low percentage partial credits.
- No late submission will be accepted expect those with prior approval from Prof. Chang-Hasnain.
- Problems of this HW are from Hambley 4th Edition
- Problems 1-6 are 6 points each, 7-14 are 8 points each

1. P1.27
2. P1.31
3. P1.39
4. P1.43
5. P1.45
6. P1.46
7. P1.62
8. P1.63
9. P1.66
10. P1.68
11. P1.76
12. P1.77
13. P2.3
14. P2.15

Homework #1 Solutions

1.27
P=I*V
a)
Using polarity of the voltmeter: Because the direction of polarity of the ammeter is the same as that of the voltmeter, the current going through A with respect to the voltmeter is +2 A, assuming the current through VM is negligible. Thus:
P=(+2 A)X(+30 V)=60 W

Since power is positive, energy is being delivered to the element.

b)
Using polarity of the voltmeter: Because the direction of polarity of the ammeter is same as that of the voltmeter, the current going through A with respect to the voltmeter

is -2 A in this case, assuming the current through VM is negligible. Thus:
P=(-2 A)X(30 V)=-60 W
Since power is negative, energy is being taken from the element.

c)
Using polarity of the voltmeter: Because the direction of polarity of the ammeter is the same as that of the voltmeter, the current going through A with respect to the voltmeter is -2 A in this case, assuming the current through VM is negligible. Thus:
P=(-2 A)X(-30 V)=60 W
Since power is positive, energy is being delivered to the element.

1.31 5 nodes total:

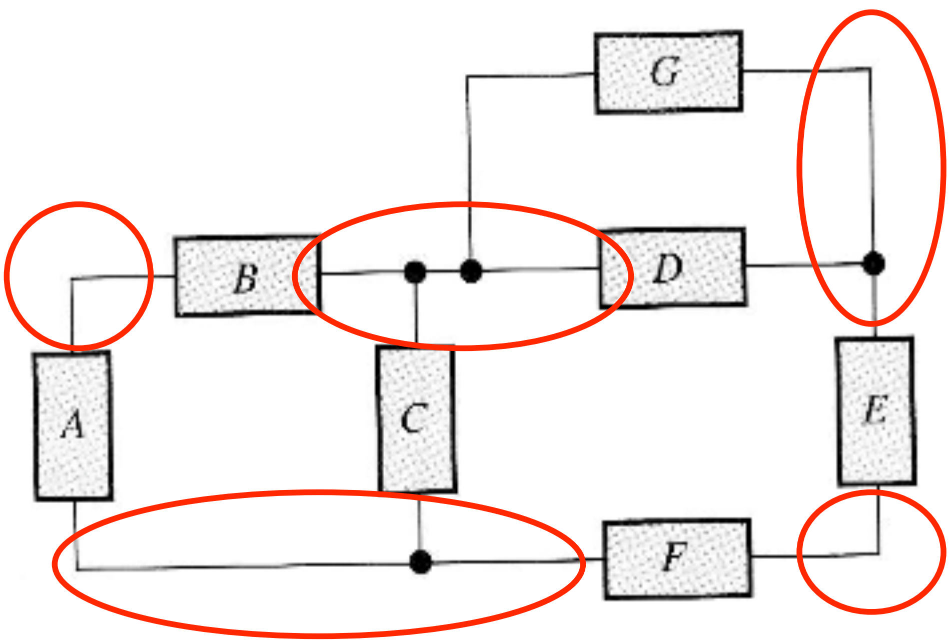


Figure P1.31

1.39
Remember to use a convention. In this case, we will choose to use arrow pointing away from the node is positive, and pointing toward is positive
We know Ia and Ic, so we can solve for Ib at the node between A, B, and C with KCL:
Ia+Ic-Ib=0 -> Ib=2A.

We know Ih and Ic, so we can solve for Ie at the node between E, H, and C with KCL:
Ih+Ic-Ie=0 -> Ie=4A.

We know Ih and Ig, so we can solve for If at the node between G, H, and F with KCL:
Ih+Ig-If=0 -> If=6A.

We now know Ib, Ie, and Ig, so we can solve for Id at the node between B,E, D, and G with KCL:
Ib+Id-Ie-Ig=0 -> Id=7A.

1.43
In this case we've chosen to solve the problem with the convention that the KVL loop runs clockwise.

Looking at the problem we notice that initially the only loop that we only have one unknown voltage in is the upper left. We will solve that first and then solve the others as we solve for the other unknown variables

Solving the upper left loop: We know Va,Vb, and Va-Vd+Vb=0 because of KVL, so Vd=12V.

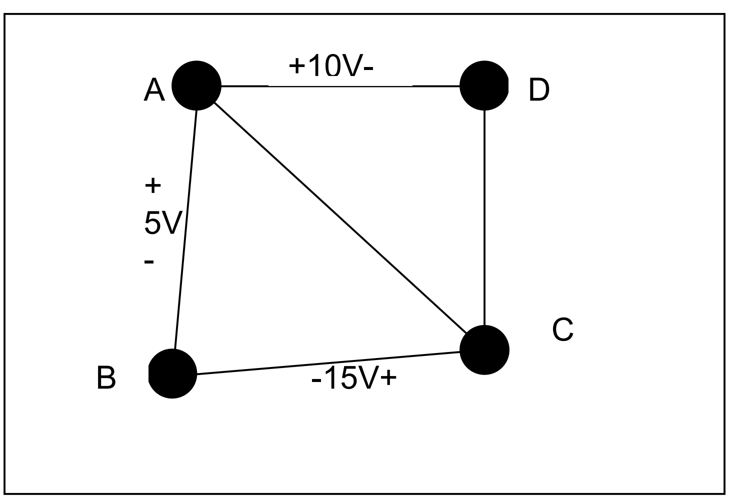
Solving the upper right loop: We know Vd,Vf, and Vd+Vf-Vg=0 because of KVL, so Vg=2V.

Solving the bottom right loop: We know Vg,Vh, and Vg+Vh-Ve=0 because of KVL, so Ve=8V.

Solving the bottom left loop: We know Vb,Ve, and Ve+Vc-Vb=0 because of KVL, so Vc= -1V.

1.45
a)
Components c, d, and e are all in parallel
b)
Nothing is in parallel in P1.43
c) c and d are in parallel.

1.46



We can use KCL again here to solve this system. First Vac using the bottom left triangle: Vac-Vcb-Vba=0, so Vac=-10V

For the other loop Vad+Vdc-Vac=0, so Vdc=-20V, and therefore Vcd=+20 V.

1.62
Because we have a single loop, we know the current must be the same everywhere in that loop. We know that Ir must be 2 A, because the current source is providing exactly 2A to the loop.

The power at the resistor Pr=Ir*Vr. Vr=Ir*R=(2A*5Ω)=10V. Pr=(2A*10V)=20W.
Power at the voltage source: Pvs=Ivs*Vvs. Pvs=(2A*10V)=20W.
Power at the current source: Pcs=Ics*Vcs. Vcs can be solved using KVL:
Vcs+Vr+Vvs=0, so Vcs=-20V. Pcs=(2A*-20V)=-40W.

The resistor and voltage source are absorbing power.

1.63
Ir=Vr/Ir. Because the resistor is in parallel with the voltage source, it has a voltage running across it of 10V (or this can be ascertained by KVL).

Ir=Vr/R=(10V/5Ω)=2 A

By KCL, the voltage source must have no current, so:
Pvs=0W
Pr=Ir*Vr=(2A*10V)=20W
Pcs=Ics*Vcs=(-2A*10V)=-20W

The resistor is the only element receiving power.

1.66
a)
The 2 and 3 Ω resistors are in series with the voltage source Vx

b)
The 6 and 12 Ω resistors are in parallel.

c)
The parallel set of resistors have a voltage drop of Vparallel=I*R=(.5 A*12Ω)=6V. They have an effective resistance of Reff=1/(1/R1+1/R2)= 1/(1/6+1/12)=4Ω.

Thus total current through the parallel section is I=Vparallel/Reff=(6V/4Ω)=1.5A, which is the current flowing everywhere else in the loop.

The total resistance of the circuit can be summed as the sum of the three resistances in series (including the effective resistance of the parallel section), thus Rtotal=3+4+2=9Ω.

Vx=I*Rtotal=(1.5A* 9Ω)=13.5 V

1.68

a)

This circuit is actually made up of 2 parallel sections in series, (the parallel combination of 2Ω and Rx) in series with (the parallel combination of 6Ω and 4Ω). No element is directly in series though.

b)

There are two parallel combinations:

2Ω and Rx

6Ω and 4Ω

c)

Voltage across the second resistor set is V=IR=(1A*6Ω)=6V. Total current through the second set is then the sum of current through the two individual resistors Itotal= 1A +6V/4Ω=2.5A. By KVL we know that the voltage drop across the first set of parallel resistors must be 4V. Since current is the same in all parts of the loop, we can solve for the effective resistance of the first set of resistors: Reff=V/I=4V/2.5A=1.6Ω. 1/Reff=1/2Ω+1/Rx=1/1.6. Thus Rx=8Ω.

1.76

There are both independent and dependent current sources in this circuit.

Since we know there is a 30 V drop over the 15Ω resistor we can solve the current through that resistor to be I=30V/15Ω=2A. since Ix is in the same loop, but opposite in direction, it must be -2A. The dependent current source then has a current of -1 A. Through KCL then, we can solve for Is: 0=-Is+Ix/2-Ix, thus Is=1A

The arrow showing voltage is a non-standard notation, so we will also accept answers with the voltage drop across the resistor being the other direction:

Since we know there is a -30 V drop over the 15Ω resistor we can solve the current through that resistor to be I=-30V/15Ω=-2A. since Ix is in the same loop, but opposite in direction, it must be 2A. The dependent current source then has a current of 1 A. Through KCL then, we can solve for Is: 0=-Is+Ix/2-Ix, thus Is=-1A

1.77

Independent and dependent voltage sources are present in this circuit.

We can use KVL to solve this one using Ohm's law to convert the resistance into a voltage:

-20V+(10Ω)(-Ix)+5Ix=0

Ix=-4A

2.3

a)

Without c and d, the circuit looks likes 2 sets in parallel of 2 resistors in series (the two resistors in series add up as Rs=R1+R2=50Ω). This parallel circuit can be reduced as

Reff=1/(1/Rs1+1/Rs2)= 1/(1/50+1/50)=25Ω

b)
With c and d shorted, this looks like two parallel circuits in series. Each parallel component can be reduced as Reff=1/(1/Rs1+1/Rs2)= 1/(1/20+1/30)=12Ω. These two parallel components in series are then Rs=R1+R2=24Ω

2.15
Because all of the resistors are the same 1Ω, we can assume the current splits equally at all nodes. Thus, we know at the first node down from a, 1/3 of the total current goes down each branch. At the next node in each branch, the current splits again into 2 equal parts, or 1/6 of the total current. At the third junction, two 1/6 currents combine, so the last section again has 1/3 of the total current. Thus the total voltage drop is Vtotal=(1/3A*1Ω)+(1/6A*1Ω)+ (1/3A*1Ω)=5/6 V