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Electric Circuits
ECSE 2010

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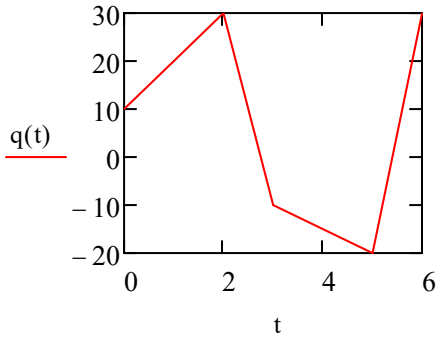
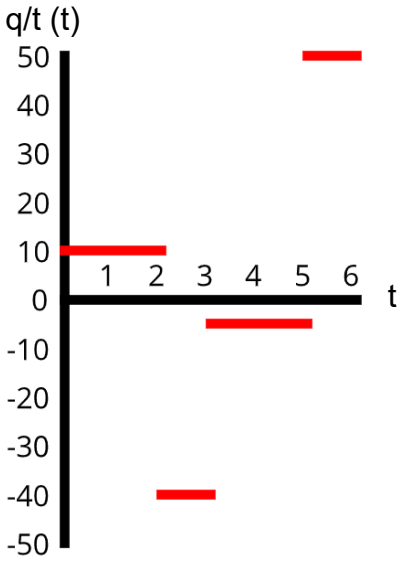
HW01

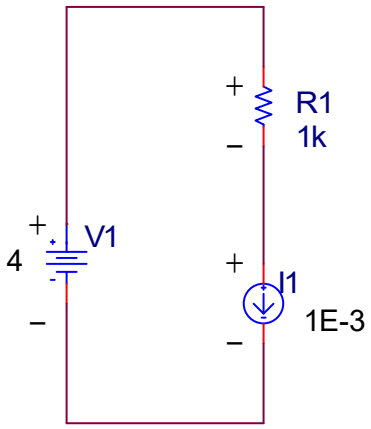
1) General Current, Voltage, or Power

The plot below is the net positve charge flowing in a wire vs. time. Sketch the corresponding current during the same period of time.





2) Source devices and Total Power



2.1: Determine the current through the voltage source, V1. Include the direction in your answer.

-1mA
(up)

2.2: Determine the voltage across the current source, I1. Include the polarity in our answer

V=IR
V(R1)=1mA*1kohm=1V
(4-1)-0=3
+3V
(positive up)

2.3: Determine the power supplied/consumed by each component and show they balance to 0W.

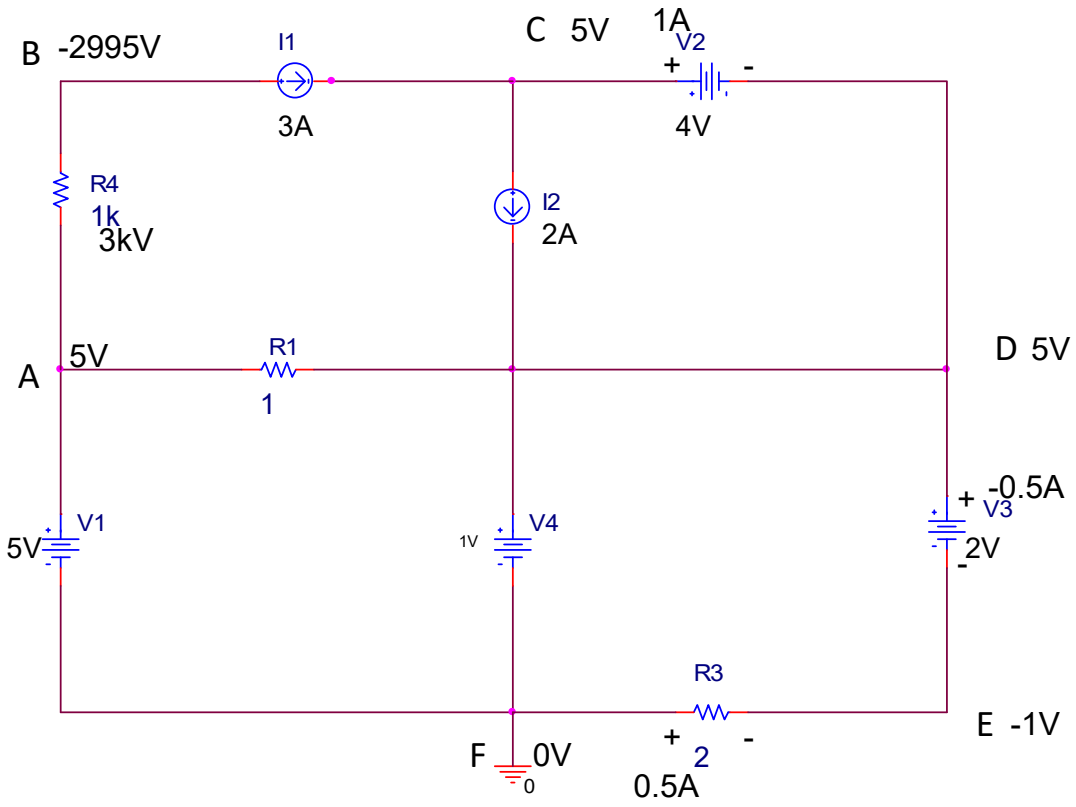
V1:
P=IV
P=-1mA*4V=-4mW (4mW supplied)

I1:
P=1mA*3V=3mW (3mW consumed)

R1:
P=1mA*1V=1mW (3mW consumed)

-4mW+3mW+1mW=0mW

3) Nodal voltages/voltage drops/currents



3.1: How many nodes are in the above circuit?

3

3.2: Determine the voltage at every node.

A:5V B:-2995V C:5V D:1V E:-1V F:0V

3.3: Determine the current through R3, V2, and V3 (label or indicate current direction for full credit)

R3:0.5A V2:1A V3:-0.5A

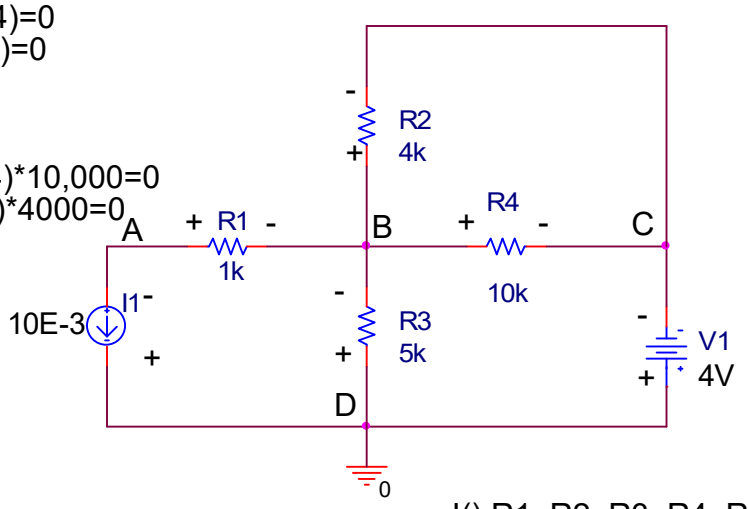
4) KVL/KCL

In this circuit,

4.1: Determine four linearly independent equations for the voltage across the resistors. You will have to use a combination of Ohm's law, KCL, and KVL.

Redraw the circuit with polarities for full credit.

A: -I(I1)+I(R1)=0
B: -I(R1)+I(R2)-I(R3)+I(R4)=0
V1R3R4: -V(V1)+V(R3)+V(R4)=0
R3V1R2: -V(R3)+V(V1)-V(R2)=0
V=IR I=V/R
A: .01+I(R1)=0
B: -I(R1)+I(R2)-I(R3)+I(R4)=0
V1R3R4: -4+I(R3)*5000+I(R4)*10,000=0
R3V1R2: -I(R3)*5000+4-I(R2)*4000=0



4.2: Set up these equations in matrix/vector form.

I() R1 R2 R3 R4 RHS
[1 0 0 0 -0.01]
[-1 1 -1 1 0]
[0 0 5000 10000 4]
[0 -4000 -5000 0 -4]

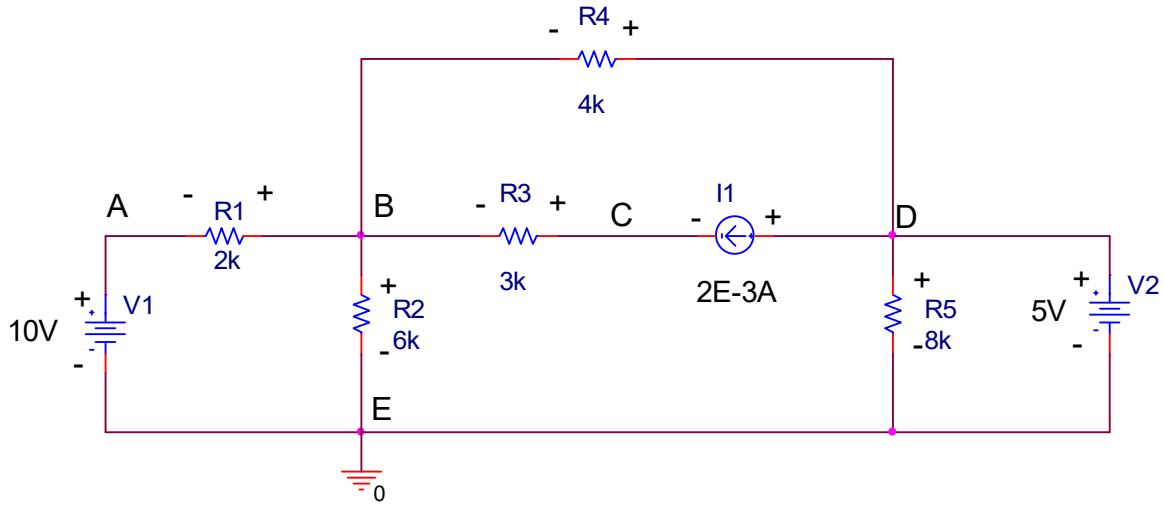
4.3: Solve for the voltages across each resistor.

V=IR

I(R1)=-0.01 V(R1)=-0.01*1000 =-10V
I(R2)=-0.004181818 V(R2)=-0.004181818*4000 =-16.727272V
I(R3)=0.0041454545 V(R3)=0.0041454545*5000 =20.727272V
I(R4)=-0.0016727272 V(R4)=-0.0016727272*10000 =-16.727272V

A=-30.727272V
B=-20.727272V
C=-4V
D=0V

5) KVL/KCL



In the above circuit,

5.1: Determine five linearly independent equations for the voltage across the resistors. You will have to use a combination of Ohm's Law, KCL, and KVL.

5.2: Set up these equations in matrix/vector form.

5.3: Solve for the currents through each resistor. Use some software like Maple or Matlab or online tools.

B: I(R1)+I(R2)-I(R3)-I(R4)=0
C: I(R3)-I(I1)=0
V1R1R2: -V(V1)-V(R1)+V(R2)=0
V2R5: -V(V2)+V(R5)=0
R2R4R5: -V(R2)-V(R4)+V(R5)=0
V=IR
B: I(R1)+I(R2)-I(R3)-I(R4)=0
C: I(R3)-.002=0
V1R1R2: -10-I(R1)*2000+I(R2)*6000=0
V2R5: -5+I(R5)*8000=0
R2R4R5: -I(R2)*6000-I(R4)*4000+I(R5)*8000=0

I()	R1	R2	R3	R4	R5	RHS
[	1	1	-1	-1	0	0]
[	0	0	1	0	0	.002]
[	-2000	6000	0	0	0	10]
[	0	0	0	0	8000	5]
[	0	-6000	0	-4000	8000	0]

	V=IR	
I(R1)=-.0005	V(R1)=-.0005*2000	=-1V
I(R2)=.0015	V(R2)=.0015*6000	=9V
I(R3)=.002	V(R3)=.002*3000	=6V
I(R4)=-.001	V(R4)=-.001*4000	=-4V
I(R5)=.000625	V(R5)=.000625*8000	=5V

A=10V
B=9V
C=15V
D=5V
E=0V

$$t := 0, 1 .. 6$$

$$q(t) := \text{if}\left(t \le 2, 10 + 10 \cdot t, \text{if}\left(t \le 3, -5t + 5, \text{if}\left(t \le 4, -5t + 5, \text{if}\left(t \le 5, -5t + 5, \text{if}\left(t \le 6, 5t, 0\right)\right)\right)\right)\right)$$