Problem#1: Problem 1-3 textbook

An ampere-hour (Ah) measures the time integral of the current. The recording of this meter in an 8-hour period is 3300 Ah. Find the number of coulombs that flowed through the meter during the recording time period.

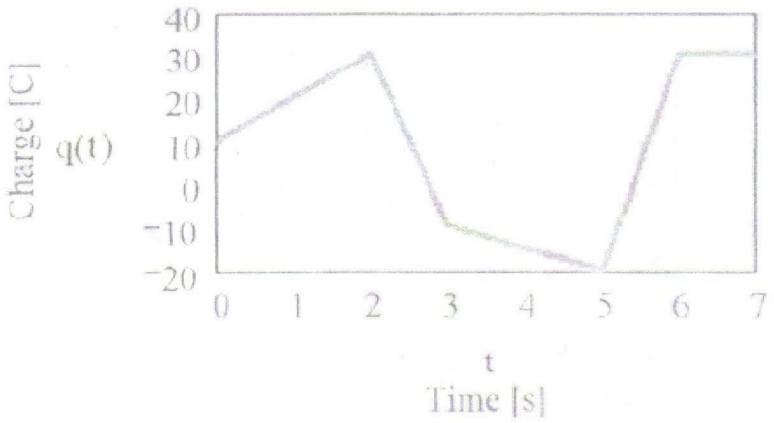
$$1 \text{ ampere} = \frac{1 \text{ coulomb}}{\text{second}} \qquad i = \frac{\Delta q}{\Delta t}$$

$$1 \text{ hour} = 60 \cdot 60 = 3600 \text{ seconds} \quad \Rightarrow \quad \underline{1 \text{ Ah} = 3600 \text{ coulombs}}$$

$$3300 \text{ Ah} = 3300 \cdot 3600 = 11.88 \cdot 10^6 \text{ coulombs} = \boxed{11.88 \text{ MC}}$$

Problem#2: Problem 1-8 textbook

The Figure shows the plot of the net positive charge flowing in a wire. Using MATLAB sketch the plot of the current during the same time period.

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>> stairs([0,1,2,3,4,5,6,7],[10,10,-40,-5,-5,50,0,0])
>> grid
>> xlabel('Time [s]')
>> ylabel('Current [A]')
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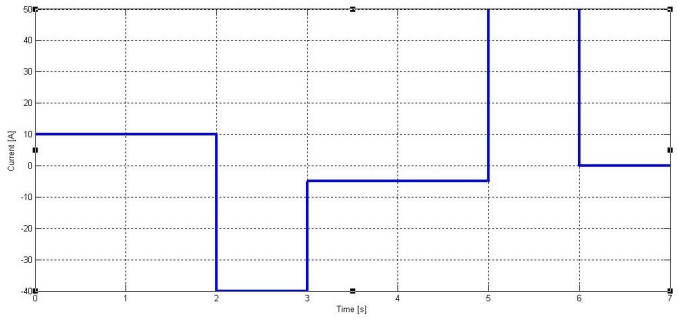


Problem#3: Problem 1-9 textbook

The net positive charge flowing through the device varies with the equation $q(t) = 3t^2$ C. Find the current through the device at t=0,t=1 and t=3 sec.

$$i = \frac{dq}{dt} \Rightarrow i(t) = \frac{d(3t^2)}{dt} = 6t \text{ A}$$

$i(0) = 0$ A

$i(1) = 6$ A

$i(3) = 18$ A

t [s]	i [A]
0	0
1	6
3	18

Problem#4: Problem 1-17 textbook

The *i-v* relationship of a photocell is $i = e^v - 10$ A. For v=-2,2 and 3 V find the device power and state if it is absorbing power or delivering power.

(i) $v = -2$

$i = e^{-2} - 10 = -9.865$ A

$p = v \cdot i = (-2) \cdot (-9.865) = 19.73$ W ABSORBING (p>0)

(ii) $v = 2$

$i = e^{2} - 10 = -2.611$ A

$p = v \cdot i = (2) \cdot (-2.611) = -5.222$ W DELIVERING (p<0)

(iii) $v = 3$

$i = e^{3} - 10 = 10.086$ A

$p = v \cdot i = (3) \cdot (10.086) = 30.258$ W ABSORBING (p>0)

Problem#5: Problem 1-14 textbook

An incandescent lamp absorbs 60 W when connected to 120-V source.

a) Find the current through the lamp.
b) Find the cost of operating the lamp for 24 hours when electricity cost is 6.8 cents/kWh.

(a) $i = \frac{P}{V} = \frac{60\ W}{120\ V} = \boxed{0.5\ A}$

(b) NOTE the watt-hour (Wh) is a unit of energy. Recall that $1\ watt = \frac{1\ joule}{1\ second}$

therefore $1\ Wh = 1\ W \cdot 3600\ s = 3600\ J$

$1\ kWh = 1000\ Wh = 3.6 \cdot 10^6\ J$

$60\ W \cdot 24\ hr = 1440\ Wh = 1.44\ kWh$

$cost = 6.8\ \frac{cents}{kWh} \cdot 1.44\ kWh = 9.792\ cents = \boxed{0.09792\ \$}$

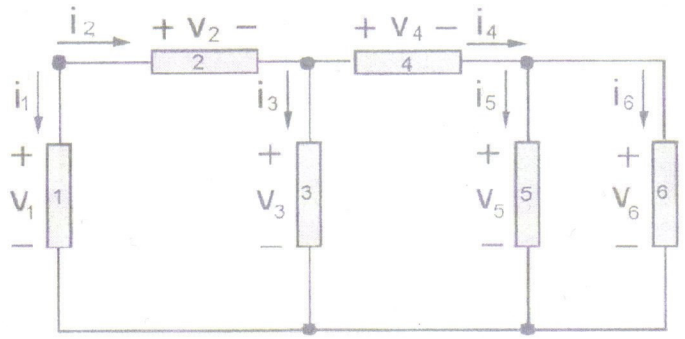
Problem#6: Problem 1-19 textbook

The maximum power a device can dissipate is 0.5 W. Determine the maximum current allowed by the device power rating when voltage is 15 V.

$i_{max} = \frac{P_{max}}{V} = \frac{0.5\ W}{15\ V} = 0.0333\ A = \boxed{33.3\ mA}$

Problem#7: Problem 1-23 textbook

The Figure shows a circuit with voltage and current variable assigned to each of the six devices. Use power balance to find v_4 when v_1=20 V, i_1= -2 A, p_2=20 W, p_3=10W, i_4=1 A, and p_5=p_6=2.5 W. Is device 4 absorbing or delivering power?



$P_1 = v_1 \cdot i_1 = (20)\cdot(-2) = -40\,W$

POWER BALANCE : $P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 0$

$P_4 = -(P_1 + P_2 + P_3 + P_5 + P_6) = -(-40 + 20 + 10 + 2.5 + 2.5) = -(-5) = \boxed{5W}$

$P_4 = 5W > 0 \Rightarrow$ device 4 is ABSORBING POWER

$V_4 = \frac{P_4}{i_4} = \frac{5W}{1A} = \boxed{5V}$

Problem#8: Problem 2-2 textbook

A 6.2 kΩ resistor dissipates 12mW. Find the current through the resistor.

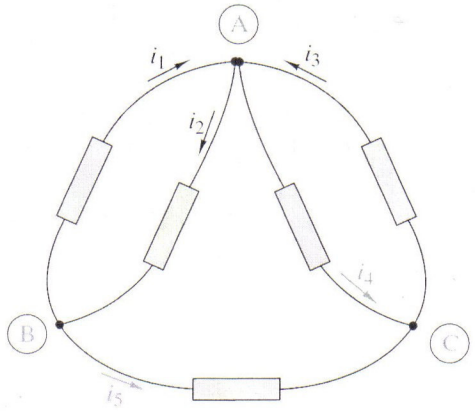
$R = 6.2\,k\Omega = 6.2\cdot10^3\,\Omega$

$p = 12\,mW = 12\cdot10^{-3}\,W$

$p = i^2R \Rightarrow i = \sqrt{\frac{P}{R}} = \sqrt{\frac{12\cdot10^{-3}}{6.2\cdot10^3}} = \sqrt{\frac{12\cdot10^{-6}}{6.2}} = \boxed{1.39\,mA}$

Problem#9: Problem 2-17 textbook

In Figure i_2=2 A, i_3= -5 A, and i_4= 4 A. Find i_1 and i_5.



NODE (A) $i_1 + i_3 = i_2 + i_4$

$i_1 = i_2 + i_4 - i_3 = 2 + 4 - (-5) =$ **11 A**

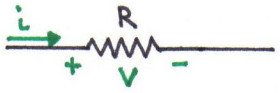
NODE (B) $i_1 + i_5 = i_2$

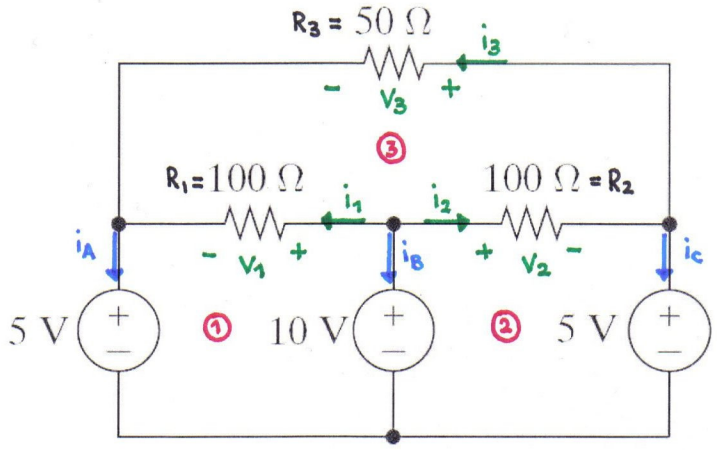
$i_5 = i_2 - i_1 = 2 - (11) =$ **-9A**

Problem#10: Problem 2-22 textbook

a) Use the passive sign convention to assign a voltage and current to every element
b) Use KVL to find the voltage across each resistor.
c) By using Ohm's law find the current through each resistor.
d) Use KCL to find the current through each voltage source.

PASSIVE SIGN CONVENTION





(b) KVL LOOP ① $5 + V_1 = 10 \Rightarrow V_1 = 5V$

LOOP ② $10 = V_2 + 5 \Rightarrow V_2 = 5V$

LOOP ③ $V_1 = V_2 + V_3 \Rightarrow V_3 = V_1 - V_2 = 0V$

(c) $i = \frac{V}{R}$ $\quad i_1 = \frac{5}{100} = 0.05A = 50\ mA$

$i_2 = \frac{5}{100} = 50mA$

$i_3 = 0A$

(d) $i_A = i_1 = 50\ mA$

$i_B = -i_1 - i_2 = -100\ mA$

$i_C = 50\ mA$

NOTE: voltage sources do not necessarily deliver power (think about what happens when we charge batteries)