# Physics 3B Week 8: Current and Direct Current Circuits



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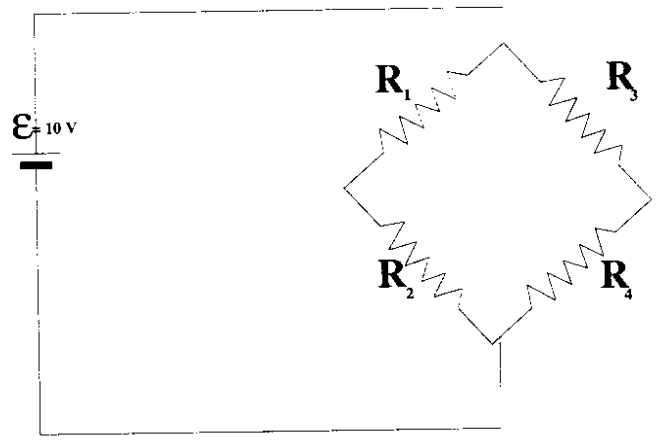
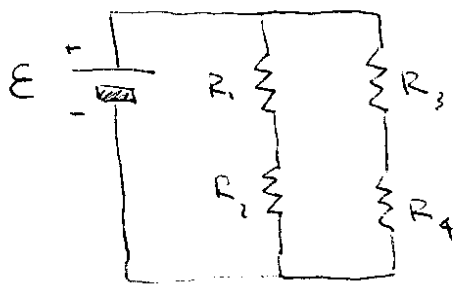
Date: February 27, 2008 Day: Wednesday Hour: 8:00 - 12:50

## 1. Problem 1

A $\mathcal{E} = 10$ Volt battery is connected across four resistors. (a) Find the voltage drop across each resistor. (b) Find the current through each resistor. The four resistors have resistance: ( $\mathbf{R}_1 = 1\Omega$, $\mathbf{R}_2 = 4\Omega$, $\mathbf{R}_3 = 8\Omega$, $\mathbf{R}_4 = 2\Omega$. )



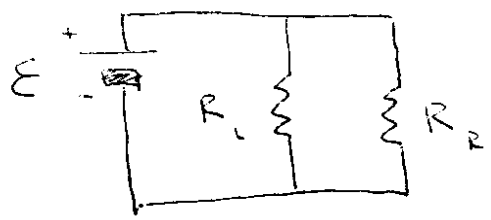

the circuit looks like this:



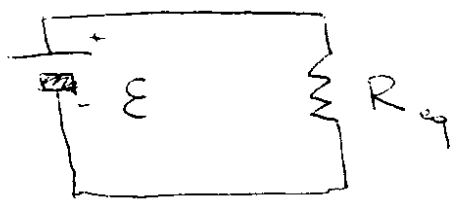

Resistors in series: $R_L = R_1 + R_2$ (Left)

$R_R = R_3 + R_4$ (Right)

Resistors in parallel:




$\frac{1}{R_{eq}} = \frac{1}{R_L} + \frac{1}{R_R}$




$R_L = 1\Omega + 4\Omega = 5\Omega$.

$R_R = 8\Omega + 2\Omega = 10\Omega$.

$\frac{1}{R_{eq}} = \frac{1}{5\Omega} + \frac{1}{10\Omega} = \frac{3}{10}\frac{1}{\Omega} \Rightarrow R_{eq} = \frac{10}{3}\Omega$.

the total current:

$$I R_{eq} = \Delta V = \mathcal{E} = 10\,V, \Rightarrow I = \frac{\Delta V}{R_{eq}} = \frac{10V}{10/3\,\Omega} = 3A$$

the individual currents:

$$I_L = \frac{\Delta V}{R_L} = \frac{10}{5} = 2A; \quad I_R = \frac{\Delta V}{R_2} = \frac{10}{10} = 1A,$$

since $R_1$ and $R_2$ in series $\Rightarrow I_L = I_1 = I_2 = 2A$; $I_R = I_3 = I_4 = 1A$

$R_3$ // $R_4$ in series

$\Delta V_1 = I_1 R_1 = 2 \cdot 1 = 2\,V$; $\Delta V_3 = I_3 R_3 = 1 \cdot 8 = 8V$

$\Delta V_2 = I_2 R_2 = 2 \cdot 4 = 8\,V$; $\Delta V_4 = I_4 R_4 = 1 \cdot 2 = 2V$

## 2. Problem 2

Vector $\mathbf{A} = -2\,\hat{\mathbf{j}}$ and vector $\mathbf{B} = 3\,\hat{\mathbf{k}}$, calculate magnitude and direction of $\mathbf{C} = \mathbf{A} \times \mathbf{B}$, and draw the vectors in a Cartesian coordinate system, labeling all vectors (**A**, **B**, and **C**).

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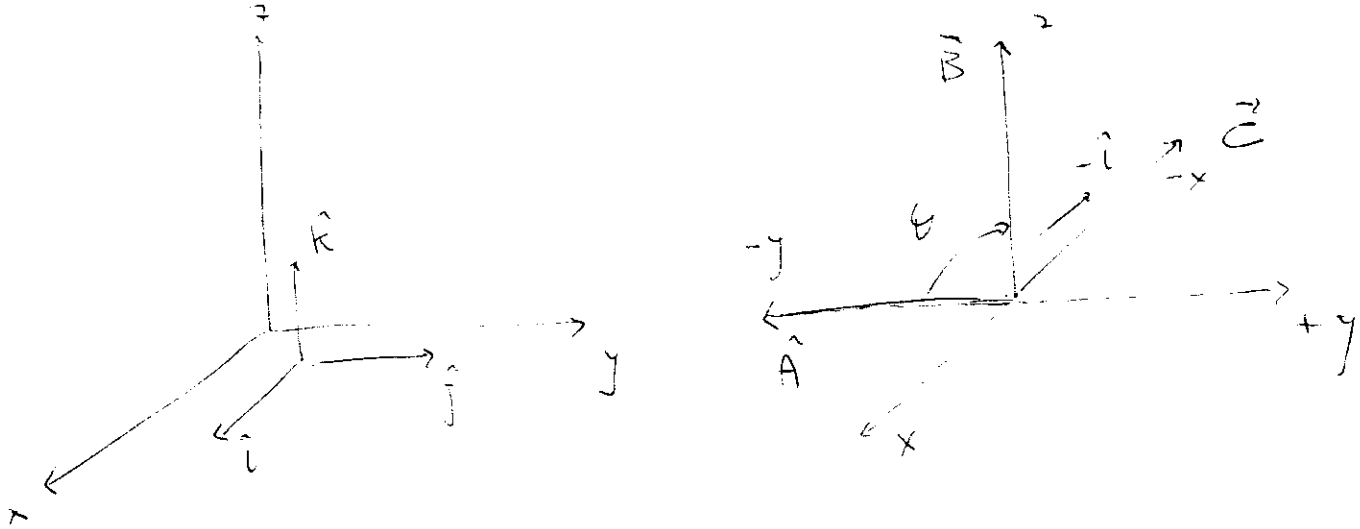


$$|\vec{C}| = AB\sin\theta = 6\sin 90^\circ = 6$$

$$\vec{C} = -6\hat{i}$$