Name _____ Date _____

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PH 102 Quiz 1: Mostly Current and Resistance

Note: Ω is the symbol for Ohms, or Volts per Ampere.

1. An electric current is:

- ⊗ The rate at which charge flows through a surface
- ◯ The rate at which electric potential changes
- ◯ The number of charges per unit volume
- ◯ A flow of electrons

Electric Current:
If a net amount of charge ΔQ flows perpendicularly through a surface cross section of area A in a time interval Δt, the electric current I is the net charge divided by the amount of time:

$$I \equiv \frac{\Delta Q}{\Delta t} \tag{1}$$

In other words, current is charge flow per unit time. **Units: Coulombs per second (C/s) or Amperes (A).**

2. Which of the following correctly states Ohm's law:

- ◯ $\Delta V = I/R$
- ⊗ $\Delta V = IR$
- ◯ $R = I/\Delta V$
- ◯ $I = \Delta Q/\Delta t$

Ohm's Law:
Current through and voltage across a conductor are proportional, the constant of proportionality is the **resistance** of the conductor.

$$\Delta V = IR \qquad \text{or} \qquad R = \frac{\Delta V}{I}$$

R is different for different conductors and configurations. The **units of R are volts per ampere, or Ohms** (Ω).

3. An electric current of $1\,\mu$A flows through a conductor, which results in a 1.5 mV potential difference. The resistance of the conductor is:

- ◯ $1.5\,\Omega$
- ◯ $6.6 \times 10^{-4}\,\Omega$
- ◯ $1.5 \times 10^{-9}\,\Omega$
- ⊗ $1500\,\Omega$

Using Ohm's Law:

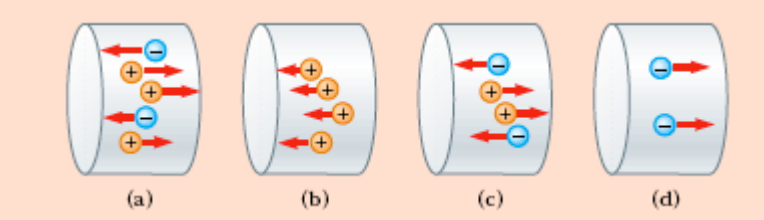
$$R = \frac{\Delta V}{I} = \frac{1.5\,\text{mV}}{1\,\mu\text{A}} = \frac{1.5 \times 10^{-3}\,\text{V}}{1.0 \times 10^{-6}\,\text{A}} = \frac{1.5 \times 10^{\cancel{-3}}\,\cancel{\text{V}}}{1.0 \times 10^{\cancel{-6}3}\,\cancel{\text{A}}}\,\Omega = \frac{1.5}{10^{-3}}\,\Omega = 1.5 \times 10^{3}\,\Omega$$

4. Which of the following does not obey Ohm's law? Check all that apply.

- ◯ A resistor
- ◯ A slab of Copper
- ⊗ A diode
- ⊗ An insulator
- ⊗ A capacitor

A resistor by definition obey's Ohm's law. A normal conductor like copper also obey's Ohm's law.
A diode has a non-linear $I - V$ relationship, and therefore does not obey Ohm's law. An insulator has no mobile charges, and cannot conduct current, so therefore does not obey Ohm's law.A capacitor also does not let a constant current pass through it, and does not obey Ohm's law.

5. Consider the positive and negative charges moving horizontally through the four regions below. Which one has the highest current? Consider the $+x$ direction to be to the right.



- ⊗ A
- ◯ B
- ◯ C
- ◯ D

Remember that negative charges moving to the left are equivalent to positive charges moving to the right. For A, there are 3 positive charges moving to the right, and two negative charges moving to the left, the same as 5 positive charges moving to the right.

In B, four positive charges move to the left, which gives a *negative* current.

In C, two positive charges moving to the right and two negative charges moving to the left gives the same as four positive charges moving to the right.

In D, this is the same as two positive charges moving to the left, for a *negative* current.

Ranked from highest to lowest, we would have A, C, D, B.