Electrostatic Potential Formula

Here are six problems based on Ohm's Law:

1. **Problem:**
   Calculate the current flowing through a resistor of resistance $5\,\Omega$ when a potential difference of $10\,V$ is applied across it.

2. **Problem:**
   A circuit contains a battery of emf $12\,V$ and internal resistance $1\,\Omega$. Calculate the current in the circuit when the external resistance is $3\,\Omega$.

3. **Problem:**
   Three resistors of $2\,\Omega$, $4\,\Omega$, and $6\,\Omega$ are connected in series to a $12\,V$ battery. Calculate the total resistance and the current flowing through the circuit.

4. **Problem:**
   Two resistors of $5\,\Omega$ and $10\,\Omega$ are connected in parallel. Calculate the equivalent resistance and the current through each resistor if a $15\,V$ battery is connected across the combination.

5. **Problem:**
   A copper wire of resistance $1\,\Omega$ is connected to a voltage source of $20\,V$. Calculate the power dissipated in the wire.

6. **Problem:**
   A heater uses a current of $5\,A$ when connected to a $220\,V$ supply. Calculate the resistance of the heater and the energy consumed in $2\,hours$.

Answer Key

1. **Solution:**

$$I = \frac{V}{R} = \frac{10\,V}{5\,\Omega} = 2\,A$$

2. **Solution:**
   Total resistance, $R_{total} = R_{internal} + R_{external} = 1\,\Omega + 3\,\Omega = 4\,\Omega$

$$I = \frac{V}{R_{total}} = \frac{12\,V}{4\,\Omega} = 3\,A$$

3. **Solution:**
   Total resistance, $R_{total} = 2\,\Omega + 4\,\Omega + 6\,\Omega = 12\,\Omega$

$$I = \frac{V}{R_{total}} = \frac{12\,V}{12\,\Omega} = 1\,A$$

4. **Solution:**
   Equivalent resistance, $\frac{1}{R_{eq}} = \frac{1}{5\,\Omega} + \frac{1}{10\,\Omega}$

$$R_{eq} = \frac{10\,\Omega \cdot 5\,\Omega}{10\,\Omega + 5\,\Omega} = \frac{50}{15}\,\Omega = 3.33\,\Omega$$

$$I_{total} = \frac{V}{R_{eq}} = \frac{15\,V}{3.33\,\Omega} \approx 4.5\,A$$

   Current through $5\,\Omega$ resistor:

$$I_1 = \frac{V}{R} = \frac{15\,V}{5\,\Omega} = 3\,A$$

   Current through $10\,\Omega$ resistor:

$$I_2 = \frac{V}{R} = \frac{15\,V}{10\,\Omega} = 1.5\,A$$

5. **Solution:**
   Power dissipated, $P = \frac{V^2}{R} = \frac{20^2}{1} = 400\,W$

6. **Solution:**
   Resistance of the heater, $R = \frac{V}{I} = \frac{220\,V}{5\,A} = 44\,\Omega$
   Energy consumed, $E = P \cdot t = V \cdot I \cdot t = 220\,V \cdot 5\,A \cdot 2\,h = 2200\,Wh = 2.2\,kWh$