Complete each of the following problems to the best of your ability. Work together in groups, explaining and assisting each other. Everyone should demonstrate the complete solution to each problem on their own paper, and each person will turn in their own paper for evaluation and credit.

1. (5 points) A 120-V electrical line in a home is connected to a 60-W lightbulb, a 180-W television set, a 300-W desktop computer, a 1050-W toaster, and a 240-W refrigerator. (Reference: Problem 16.41)
   A) How much current is being drawn?
   B) If the circuit is connected to a 20A breaker, can you also plug in and switch on an 1800W hair dryer without tripping the breaker?
   C) Circuits are parallel, so same 120V for each!

   Appliance #6, the blow dryer, will trip the breaker. Switching it on brings the current draw well over the 20A limit!

2. (5 points) In the circuit shown below in Figure 03, the resistors $R_1 = 20\Omega$, $R_2 = 10\Omega$, $R_3 = 30\Omega$ and $R_4 = 20\Omega$ are connected to a power supply with $\varepsilon = 100V$.
   A) Replace the resistors $R_1$, $R_2$, $R_3$, and $R_4$ with a single equivalent resistor, $R$.

   Ohm’s Law reduces the circuit to find the equivalent resistance and total current, but Kirchhoff will give you the remaining currents quickly!
3. (5 points) Two incandescent lightbulbs use 40W and 60W, respectively, when connected in parallel to a 120-V source. How much power does each bulb use when connected in series across the same 120-V source, assuming that their resistances remain the same? (Reference: Problem 16.44)

\[
P_1 = \frac{V^2}{R_1} \quad \Rightarrow \quad R_1 = \frac{V^2}{P_1} = \frac{(120\text{V})^2}{40\text{W}} = 360\Omega \\
P_2 = \frac{V^2}{R_2} \quad \Rightarrow \quad R_2 = \frac{V^2}{P_2} = \frac{(120\text{V})^2}{60\text{W}} = 240\Omega \\
R = R_1 + R_2 = 360\Omega + 240\Omega = 600\Omega \\
V = IR \quad \Rightarrow \quad I = \frac{V}{R} = \frac{120\text{V}}{600\Omega} = 0.200\text{A} \\
P_1 = I^2 R_1 = (0.20\text{A})^2 (360\Omega) = 14.4\text{W} \\
P_2 = I^2 R_2 = (0.20\text{A})^2 (240\Omega) = 9.6\text{W}
\]

4. (5 points) A platinum resistance thermometer consists of a coil of 0.15-mm-diameter platinum wire wrapped in a coil. Determine the length of wire needed so that the coil’s resistance at \( T = 20°C \) is \( R = 25Ω \). The resistivity of platinum at this temperature is \( \rho = 1.0 \times 10^{-7}\Omega\cdot\text{m} \). (Reference: Problem 16.49)

\[
d = 0.15\text{mm} = 1.5 \times 10^{-4}\text{m} \\
r = \frac{d}{2} = 7.5 \times 10^{-5}\text{m} \\
R = \frac{\rho L}{A} \quad \Rightarrow \quad L = \frac{(\pi r^2)R}{\rho} \\
L = \frac{\pi (7.5 \times 10^{-5}\text{m})^2 (25Ω)}{(1.0 \times 10^{-7}\Omega\cdot\text{m})} = 4.42\text{m}
\]

5. (5 points) A battery produces a current \( I_1 = 2.5\text{A} \) when connected to an unknown resistor of resistance \( R_1 \). When a second resistor, \( R_2 = 10Ω \) is connected in series with \( R_1 \), the current drops to \( I_2 = 1.5\text{A} \). Determine the battery voltage \( V \) and the resistance \( R_1 \). (Reference: Problem 16.55)

\[
V = I_1 R_1 \quad \Rightarrow \quad V = (2.5)R_1 \\
V = I_2 (R_1 + R_2) \quad \Rightarrow \quad V = (1.5) (R_1 + 10) \\
(2.5)R_1 = (1.5)(R_1 + 10) \\
(2.5 - 1.5)R_1 = (1.5)(10) \quad \Rightarrow \quad R_1 = 15Ω \\
V = (2.5\text{A})(15Ω) = 37.5\text{V}
\]