Name_____ SP222 Quiz

The measured current in a circuit in your uncle's house is 12.5 A. In this circuit, the only appliance that is on is a space heater that is being used to heat the bathroom. A pair of 12-gauge copper wires carries the current from the supply panel in your basement to the wall outlet in the bathroom, a distance of 30.0 m each way.

Table 25-1

Material	Resistivity ρ at 20°C, $\Omega \cdot m$	Temperature Coefficient α at 20°C, K^{-1}
Conducting Elements		
Aluminum	2.8×10^{-8}	3.9×10^{-3}
Copper	1.7×10^{-8}	3.93×10^{-3}
Iron	10×10^{-8}	5.0×10^{-3}
Lead	22×10^{-8}	4.3×10^{-3}
Mercury	96×10^{-8}	0.89×10^{-3}
Platinum	100×10^{-8}	3.927×10^{-3}
Silver	1.6×10^{-8}	3.8×10^{-3}
Tungsten	5.5×10^{-8}	4.5×10^{-3}
Carbon	3500×10^{-8}	-0.5×10^{-3}
Conducting alloys		
Brass	$\sim 8 \times 10^{-8}$	2×10^{-3}
Constantin (60% Cu, 40% Ni)	$\sim 44 \times 10^{-8}$	0.002×10^{-3}
Manganin (~84% Cu, ~12% Mn, ~4% Ni)	44×10^{-8}	0.000×10^{-3}
Nichrome	100×10^{-8}	0.4×10^{-3}
Semiconductors		
Germanium	0.45	-48×10^{-3}
Silicon	640	-75×10^{-3}
Insulators		
Neoprene	$\sim 10^{13}$	
Polystyrene	$\sim 10^{14}$	
Porcelain	$\sim 10^{12}$	
Wood	$10^{8} - 10^{11}$	
Glass	$10^{10} - 10^{14}$	
Hard rubber	$10^{13} - 10^{16}$	
Amber	5×10^{14}	
Sulfur	1×10^{15}	
Teflon	1×10^{13}	
Body material		
Blood	1.5	
Fat	25	

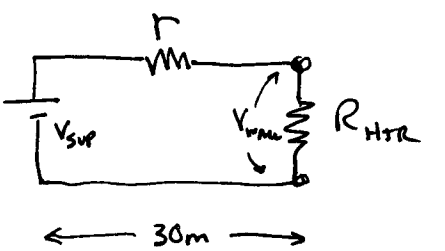
Table 25-2

AWG* Gauge Number	Diameter† at 20°C, mm	Area, mm^2
4	5.189	21.15
6	4.115	13.30
8	3.264	8.366
10	2.588	5.261
12	2.053	3.309
14	1.628	2.081
16	1.291	1.309
18	1.024	0.8235
20	0.8118	0.5176
22	0.6438	0.3255

* American wire gauge.

† The diameter d is related to the gauge number n by

Draw circuit here:



What is the resistance of the wires carrying the current to the bathroom and back?

$$r = \frac{\rho l}{A} = \frac{(1.7\times10^{-8}\,\Omega\cdot m)(60\,m)}{3.309\,mm^2\left(\frac{1\,m}{1000\,mm}\right)^2} = .308\,\Omega$$

You measure the voltage at the supply panel to be exactly 120 V. What is the voltage at the wall outlet in the bathroom that the space heater is connected to considering the resistance in the wires? (hint: the resistance of the wires is in series with the space heater.)

$$V_{SUP} - Ir - V_{WALL} = 0 \qquad V_{SUP} - Ir = V_{WALL}$$

$$V_{WALL} = 120V - (12.5A)(.308\Omega) = 116V$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots. \qquad R_{eq} = R_1 + R_2 + \ldots.. \qquad V_{ba} = I\left(\rho\frac{\ell}{A}\right) = IR$$

Extra Credit: Who invented the wooden coat hanger?