

EECE 2150 - Electrical Engineering Fall 2021

Quiz 2

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Student Name: _____

A certain 40 Watt quartz-halogen lamp has a filament 60 cm long (remember that it's a coil of tungsten wire so the length of the wire is a lot longer than the length of the coil. The lamp will be operated at a voltage of 12 V Tungsten at a temperature of 3500 Kelvin has a resistivity of $1.11 \mu\text{Ohm} \cdot \text{m}$. Furthermore, the filament has a resistivity of $5.65 \text{ nanoOhm} \cdot \text{m}$ at room temperature.

The filament has a radius r which we wish to calculate.

1. What must be the resistance of the filament?

_____ Ohms

2. What must be the radius of the filament?

_____ mm.

3. What is the resistance of the filament, measured with an Ohmmeter (ie. with the filament at room temperature).

_____ Ohms

4. How would our results change if we used the United States line voltage, $V = 120 \text{ V}$? Specifically what would be the new answers for questions 1 and 2?

_____ Ohms _____ mm

5. Would this be a problem? Why?

1. What must be the resistance of the filament?

$$R = \frac{V^2}{P} = 3.6 \text{ Ohms}$$

2. What must be the radius of the filament?

$$R = \frac{\rho \ell}{\pi r^2} \quad r = \sqrt{\frac{\rho \ell}{\pi R}} = 243 \mu\text{m}.$$

3. What is the resistance of the filament, measured with an Ohmmeter (ie. with the filament at room temperature).

$$R = \frac{\rho \ell}{\pi r^2} = 0.018 \text{ Ohms}.$$

4. How would our results change if we used the United States line voltage, $V = 120 \text{ V}$? Specifically what would be the new answers for questions 1 and 2?

360 Ohms $2.43 \mu\text{m}$

5. Would this be a problem? Why?

Yes. The thin filament could melt easily resulting in a short lifetime for the lamp.