Lab 6: Blackbody radiation

Goal: Using an incandescent light bulb as a source of blackbody radiation, the T^n dependence on the power radiated, where T is temperature and n is an exponent, will be explored. The value of the exponent n will be compared against the theoretical value of 4.

There are two variables to be obtained in this experiment: temperature of the tungsten filament, and power radiated by the light bulb P. The set-up is shown in Fig. 1.

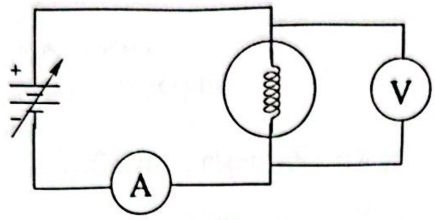

Figure 1. The voltage drop across the light bulb and the current through it are measured in the experimental set-up.

Power:

Conservation of energy dictates that the total power P radiated from the light bulb is equal to the power dissipated in the resistor. Therefore, by measure the voltage drop V across the bulb and the current I delivered to the bulb, the power radiated can be measured. Bulb is rated for 12.5 V.

Temperature:

Additionally, from V and I, the resistance R of the bulb can be calculated. The resistance is directly proportional to the resistivity ρ of the bulb, and the resistivity can be used as a temperature sensor.

For tungsten, the relationship between resistivity and temperature can be modelled as $T = A\rho^B$. A and B can be found by fitting tabulated data, T as a function of ρ, to a power law; only the constant B is needed for the experiment. The data is in an Excel file under the name "ResistivityTungsten" in blackboard. A linear fit

$y = m\,x + b$ can be used with $y = \ln T$, $x = \ln \rho$, to find the slope m equal to B. Do this fit as part of the pre-lab and include the graph and value of B.

Therefore $T = T_{room}\,(R/R_{room})^B$, where R_{room} is the resistance at room temperature T_{room}. By plotting the $\ln T$ vs $\ln P$, find exponent n. Hint: Look at the homework results.