Problem 2

Determination of the Stefan-Boltzmann Constant

Listed below are the only apparatus and materials available for your experiment:

1. DC power supply
2. Heater mounted on a ceramic base
3. Digital voltmeter (labeled V) and ammeter (labeled A)
4. Caliper
5. Aluminum cylinder with polished surface and a hole to house the heater. The cylinder is fitted with a thermocouple (iron constantan) for measuring its temperature.
6. Thermally isolated vessel containing water and ice for maintaining the cold (reference) junction of the thermocouple at the constant temperature of 0^0 C.
7. Digital mV-meter (labeled mV) to be connected with the thermocouple
8. A table listing the calibrated thermoelectric characteristics of the thermocouple for converting the mV readings into the corresponding temperatures
9. Electric cables
10. Candle and safety matches for blackening the cylinder

A note on the theoretical principle:

The effective radiation of power by an object with surface S at absolute temperature T in equilibrium with its surrounding is given by the formula

$$P = e\sigma S\left(T^4 - T_0^4\right)$$

where σ is the Stefan-Boltzmann constant, T_0 I the absolute temperature of the surrounding, and e=1 for an ideal blackbody while e=0 for an ideal reflector. The room temperature will be given.

In this experiment, you are to determine the Stefan-Boltzmann constant σ .
Include the following in your report

a. The theoretical basis for the experiment
b. A description of the method and procedure of the experiment
c. The final value of Stefan-Boltzmann constant σ
d. The errors and their sources

Warnings:

1. Be careful in handling some of the elements during the experiment As they may become very hot (> 100 ^{0} C) at some stages
2. Be sure that the power supply current for the heater never exceeds 2A at all stages of the experiment.