1st ASIAN PHYSICS OLYMPIAD

KARAWACI, INDONESIA

EXPERIMENTAL COMPETITION

APRIL 27, 2000

Time available : 5 hours

READ THIS FIRST :

1. **Use only the pen provided.**
2. **Use only the marked side of the paper**
3. **Each problem should be answered on separate sheets**
4. **In your answers please user primarily symbols, equations, numbers, graphs, tables and as little text as possible.**
5. **Write at the top of every sheet in your report:**
   - **Your candidate number (APhO identification number).**
   - **The problem number and section identification, e.g.2/a.**
   - **Number each sheet consecutively.**
6. **Write on the front page the total number of sheets in your report**

This set of problems consists of .... pages

Problem 1

Determination of the Density of Oil

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

1. Test tube with uniform cross-section over most of its length between its to ends.
2. Vessel
3. Ruler
4. Eye dropper
5. Graph papers
6. Drying cloth/tissue papers
7. Rubber band for level marking
8. Distilled water with density 1.00 g/cm^3
9. Oil in a plastic cup

In this experiment, you are to determine the density of the oil without measuring the dimensions of the tube. You should not put both oil and water in the tube at the same time.

Include the following in your report:

a. The theoretical basis for the analysis
b. A description of the method and procedure of the experiment
c. Final value for the density of oil

The errors and their sources

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.