Exercise 1: Graphing Experimental Data

In this exercise, you are given a complete data set from an experiment. You are asked to graph that data and to prepare a short report describing that data, and displaying your graph and your data table.

Objectives

The objective of this project is to characterize the thermal properties of a styrofoam sample, by comparing its internal temperature with that of the ambient air and with the temperature of the air in a cold bath. In this project, cooling data is to be collected and graphed, but no mathematical analysis will be conducted.

Apparatus and Procedures

The experimental apparatus is represented in Figure 1, which shows a styrofoam sample, three thermocouples, and a cooling container. Data collection electronics are not relevant in this assignment, and are omitted from the drawing. The styrofoam sample had a mass of 0.9 g and a diameter of 38mm. The cooling container consisted of a thermos packed with dry ice and a copper insert, to be called the cold air bath in this experiment. One thermocouple was placed inside the sample, one was suspended beside the sample in the cold air bath, and the third was placed in room-temperature air near the cooling container. When the bath was placed in the dry ice container, the air inside it cooled, and the styrofoam sample cooled accordingly. At some point, the air and the sample reached a steady state, at which point data collection ended.

Assignment

You should assume that you have experimentally collected the data shown in Table 1. Please graph that data as shown in Figure 2. Then write a short report describing the goals, procedures and results of the experiment. The report should display a drawing of the apparatus, a data table and a graph of the results. The drawing, table and graph are to be inserted in the body of the report as part of the word processing file. Scissors, tape and photocopies are not an acceptable means to insert your graphs and tables into a report.

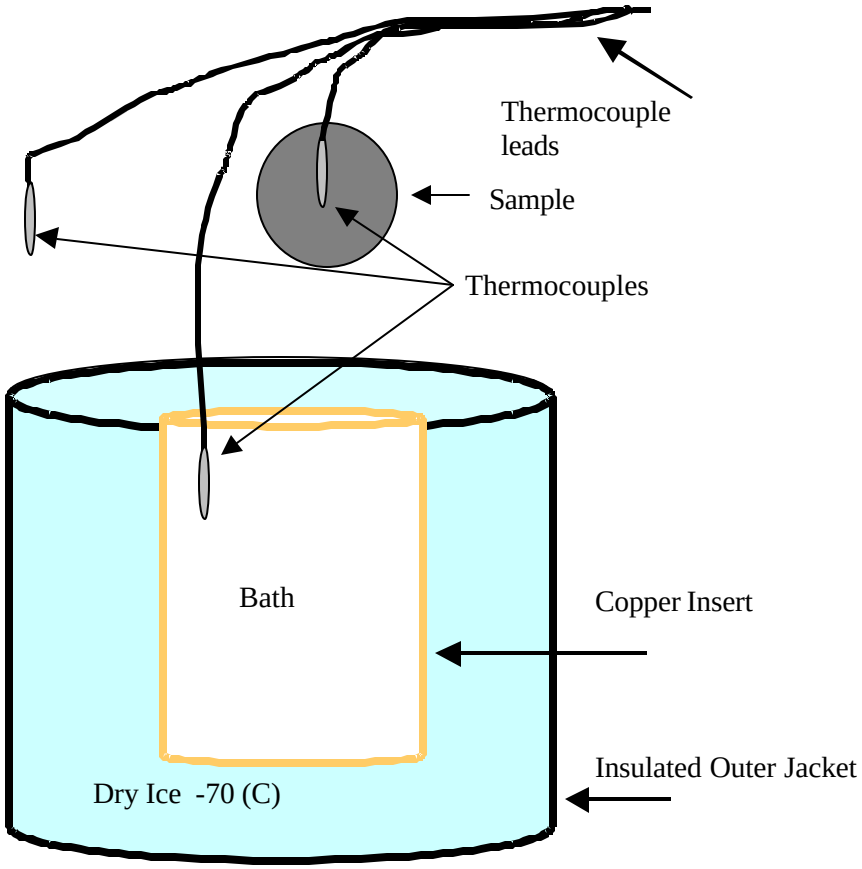

Figure 1. The cooling experiment setup, showing the dry ice container, the copper Bath, the sample and the three thermocouples. The leads from these thermocouples are connected to instruments that are unimportant in the context of this task.

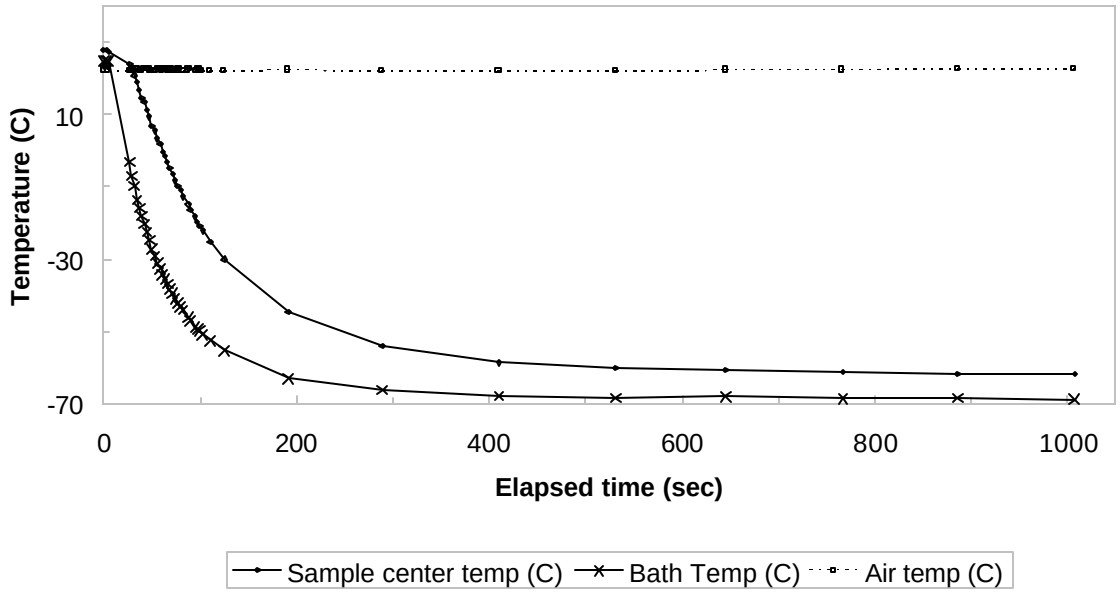

Figure 2. The internal temperature of the styrofoam ball, compared with the temperature of the air in the cold air bath and the temperature of the ambient air. It is noted that the styrofoam provides some small amount of thermal insulation.

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Table 1. The raw data for the study of a stryofoam ball placed in a cold air bath exposed to dry ice.

Elapsed time (sec)	Air temp (C)	Sample center temp (C)	Bath Temp (C)
0.000	22.351	27.754	24.713
2.250	22.979	27.754	24.713
4.830	22.351	27.477	24.713
26.690	22.142	24.022	-3.078
29.050	22.351	22.365	-7.049
31.630	22.351	20.847	-9.762
34.220	22.770	19.053	-13.648
36.800	22.142	16.844	-15.822
39.380	22.142	14.634	-18.155
41.960	22.770	13.389	-20.355
44.540	22.770	11.174	-22.420
47.180	22.351	9.372	-24.796
49.700	21.933	6.732	-27.338
53.060	22.142	5.478	-29.144
55.640	22.560	3.245	-31.112
58.220	22.770	1.705	-32.633
60.800	22.351	-0.260	-34.316
63.380	22.770	-1.385	-35.699
65.960	22.351	-3.219	-36.933
68.540	22.351	-4.776	-38.328
71.130	22.560	-6.480	-39.417
73.710	21.933	-8.332	-40.980
76.810	22.351	-9.619	-42.235
79.420	22.770	-10.766	-43.181
82.060	22.142	-12.781	-44.129
87.220	22.351	-14.951	-46.034
89.580	22.560	-16.404	-46.992
94.740	22.142	-18.301	-48.915
97.110	22.770	-19.767	-49.398
99.690	22.351	-20.797	-49.882
102.270	22.142	-22.125	-50.851
110.400	21.933	-25.392	-52.637
124.840	22.142	-30.051	-55.419
191.410	22.351	-44.604	-63.078
288.910	22.142	-54.106	-66.301
410.070	21.933	-58.725	-67.840
531.290	21.933	-60.224	-68.526
645.430	22.351	-60.726	-68.011
766.700	22.351	-61.228	-68.698
886.110	22.560	-61.732	-68.526
1007.330	22.770	-61.900	-68.870