

Fifth Problem Set Phy132
Due Wednesday, May 20

Problem 1.

The amplification (or gain) of a transistor amplifier depends on temperature. The gain for a particular amplifier at 20°C is 25.0. At 60°C the gain is 37.4. When in contact with an unknown sample, the gain of the amplifier is 29.2. If one uses the amplifier gain as a thermometer, what is the temperature of the unknown sample?

If one used a mercury thermometer to measure the temperature of the unknown sample, would the same temperature necessarily be obtained?

Problem 2.

The length of the Golden Gate Bridge is around 5000 feet. What is the change in the length of the bridge if the temperature varies from 35°F to 100°F . Assume that the bridge is made of steel.

Problem 3.

A pendulum clock is made out of Invar. The period of the clock is 0.5 seconds, and is perfectly accurate at a temperature of 20°C . If the clock is now used in a room whose temperature is 30°C , by how much is it incorrect after one month? Is it fast or slow?

Problem 4.

A rectangular plate has side of length a and b , and the area is $A = ab$. The coefficient of linear expansion of the material is α . Show that the increase in area of the plate is approximately given by: $\Delta A = 2\alpha A\Delta T$.

Problem 5.

Gloria measures the length of a brass rod with a steel tape measure at 20°C . The reading is 90.00 cm on the tape measure. What will the tape indicate for the length of the rod when both the rod and the tape are at 60°C ?

Problem 6.

You want to heat a 200 liter water tank from 20°C to 40°C in one hour using solar energy. What is the area of the solar collector needed? Assume that the intensity of the incident sunlight is 800 W/m^2 , and that the efficiency of the collector is 30%.

Problem 7.

How much steam at 100°C must be added to 100 grams of ice at -5°C to produce liquid water at 20°C in an insulated container?

Problem 8.

An electric immersion heater is to be used to heat 100 grams of water from 20°C to 100°C to make tea. If the heater is rated at 200 Watts, how long will it take to heat the water up?

Problem 9.

Lake Erie contains around $4 \times 10^{11} \text{ m}^3$ of water. The government wants to heat up the water from its normal temperature of 11°C to 12°C . It plans to use a 1000 Mega-Watt electric power plant. How long will it take to heat up the water using the power plant?

Problem 10.

A 3 gram lead bullet is traveling at 300 m/s when it embeds into a block of ice. The ice is at 0°C . Assuming that all the kinetic energy of the bullet goes into melting the ice, how many grams of ice melt when the bullet comes to rest?