

## Exercises for Experimental Physics 2 – IPSP

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### Exercise Sheet 3 (SoSe 2012)

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**Date of Submission: May 4<sup>th</sup> 2012**

**Submission Place:** Marked mailbox next to room 302 (Linnestr. 5)

**Submission Time:** 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper. Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

#### Exercises:

1. Consider the freezing of 50.0 g of water once it is placed in the freezer compartment of a refrigerator. Assume the walls of the freezer are maintained at  $-10^{\circ}\text{C}$ . The water, initially liquid at  $0.0^{\circ}\text{C}$ , is frozen into ice and cooled to  $-10^{\circ}\text{C}$ . Show that even though the entropy of the water decreases, the net entropy of the universe increases. (6 Points)
2. The cost of air conditioning a house is approximately proportional to the rate at which heat is absorbed by the house from its surroundings divided by the coefficient of performance (COP) of the air conditioner. Let us denote the temperature difference between the inside temperature and the outside temperature as  $\Delta T$ . Assuming that the rate at which heat is absorbed by a house is proportional to  $\Delta T$  and that the air conditioner is operating ideally, show that the cost of air conditioning is proportional to  $(\Delta T)^2$  divided by the temperature inside the house. (8 Points)
3. The surface temperature of the filament of an incandescent lamp is  $1300^{\circ}\text{C}$ . If the electric power input is doubled, what will the new temperature be? Hint: Show that you can neglect the temperature of the surroundings. (6 Points)
4. A 100-g piece of ice at  $0.0^{\circ}\text{C}$  is placed in an insulated calorimeter with negligible heat capacity containing 100 g of water at  $100^{\circ}\text{C}$ . (a) What is the final temperature of the water once thermal equilibrium is established? (b) Find the entropy change of the universe for this process.