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Advanced Statistical Physics, SS 2017
Sheet 2

Problem 1: **(4 points)**

a) Estimate the volume of one mole of sand grains.

b) Estimate the number of moles in a glass of water, and in the same volume of gasoline ($\approx C_8H_{18}$).

Problem 2: **(4 points)**

The energy content of foods is often given in "calories". An adult human needs at least 2000 calories each day. The nutritionist's calories are kilocalories for the physicist. The physicist's calorie is the amount of energy needed to heat one gram of water by one degree Celsius, and is equal to about 4.1 Joules.

a) Suppose that the human body converted all the chemical energy in food to work. What is the height H of the mountain you could climb after eating 2000 (nutritionist) calories?

b) Considering your answer to the previous part, where does most of the energy in your food go?

Problem 3: **(4 points)**

a) Explain how one could use the zeroth law of thermodynamics to define an empirical temperature with the property that any two systems with the same temperature are in equilibrium.

b) Explain how by using the first law one could construct an empirical temperature with the additional property that if one system is hotter than the other, it will have a higher temperature.

Deliver your hand-written solutions at the beginning of the lecture on Friday, April 28th.