Department für Physik
Arnold-Sommerfeld-Zentrum
für Theoretische Physik
Ludwig-Maximillians-Universität

SoSe 05

Set 0
4/11/05

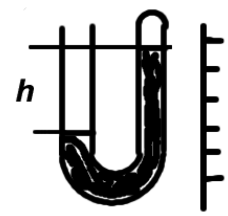
T IV: Thermodynamik und Statistik
(Prof. E. Frey)

Problem set 0

Problem 0.1

The thermal volume expansion coefficient γ and thermal length expansion coefficient α are defined according to

$$\frac{1}{V}\left(\frac{\partial V}{\partial T}\right) = \gamma\,, \quad \frac{1}{L}\left(\frac{\partial L}{\partial T}\right) = \alpha$$



here V, L and T denote volume, length, and temperature, respectively.
The thermometer was gauged at $T = 0°$ C and air pressure p. The reading of the glass scale is $h = 745$ mm at $T = 20°$ C and the same pressure. Calculate p in units of Torr, i.e. *millimeter mercury column*. (mercury: $\gamma = 1.8210^{-4}$ K^{-1}, glass: $\alpha = 8 \times 10^{-6}$ K^{-1}).

Problem 0.2

A container with a volume of $V = 2$ l filled with air is weighed at $T = 16°$C and $p_1 = 0.0957$ MPa . Its weight is 2.29g less when it is evacuated down to 800 Pa air pressure. Calculate the density of air at 0° C and 0.1013 MPa.

Problem 0.3

A calorimeter has together with its fluid content a heat capacity of 4.2 kJ/K and a temperature of 20° C. The temperature drops to 11° C upon addition of 100g ice with 0° C. Calculate the specific heat of fusion of ice. The specific heat capacity of water is 4.1868 J/(g K).

Problem 0.4 *Stirling's formula*

Prove for large n

$$n! \sim \sqrt{2\pi n}\left(\frac{n}{e}\right)^n$$

Hint: Use the identity $n! = \Gamma(n+1) = \int_0^\infty x^n e^{-x} dx$,
and apply a Taylor expansion of $f(x) = n \ln x - x$ near its maximum.

Problem 0.5

Find the probability that in a class of r students all birthdays are different. How large should the class be to expect coinciding birthdays with a probability of at least 1/2.

Problem 0.6

Suppose that 5 men out of 100 and 25 women out of 10,000 are colorblind. A colorblind person is chosen at random. What is the probability of his being male? (Assume males and females to be in equal numbers.)

Problem 0.7

A man with n keys wants to open his door and tries the keys independently and at random. Find the mean and variance of the number of trials

(a) if unsuccessful keys are not eliminated from further selection;

(b) if they are.

Tutorials:
Mo 14 -16 Uhr, Theresienstr. 37, Raum 348 Block A
Di 15 -17 Uhr, Theresienstr. 37, Raum 449 Block A
Mi 14 -16 Uhr, Theresienstr. 37, Raum 348 Block A
Do 13 -15 Uhr, Theresienstr. 37, Raum 348 Block A
Do 15 -17 Uhr, Theresienstr. 37, Raum 449 Block A
Fr 13 -15 Uhr, Theresienstr. 37, Raum 348 Block A

due Monday 04/18/05