Übungen zur Experimentalphysik I (Thermodynamik)
Aufgabenblatt 2 von 5
Abgabe im OLAT: Montag, 25.01.2021, 18:00 Uhr

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

1)

Open the fridge and went it with warm air at room temperature. Start the app phyphox on your smartphone or tablet. Start the measurement (graph) of the pressure. Put the device in the fridge and close the door carefully. Take out the device after one or two minutes. What does the graph show? Explain the trends.
Document your measurement with photos or screenshots. If you do not have a device for the measurement, ask another student for a measurement or use the graph from the discord channel.

2)

The following table gives the molar composition of dry air (volume %) and the molar masses of its components.

	N_2	O_2	Ar	CO_2
fraction in air [%]	78.08	20.95	0.93	0.04
mass [g/mol]	28.01	32.00	39.95	44.01

Calculate the density of dry air under normal conditions ($p = 1.0133 \cdot 10^5$ Pa, $T = 20°\text{C}$). Consider air to be an ideal gas.

3)

Rita transports pure Helium in a steel bottle with a volume of $V = 50$ l. Before, Rita filled the bottle up to the maximum pressure of $p_0 = 20$ MPa at a room temperature of T = 25°C. Consider Helium to be an ideal gas with a molar mass of $\text{M}_{\text{He}} = 4.0026$ g/mol.
a) Which amount of substance (in Mol) and which mass of Helium (kg) are in the bottle after filling?
b) During transport the sun heats up the bottle to 50°C. Calculate the pressure in the bottle.

4)
After the transport, Rita's gas bottle cools down to 25°C. But during storage the valve was damaged, so that Helium is leaking. The flow of Helium is proportional to the rest pressure. The temperature remains at 25°C.
a) Determine $p(t)$ by a suitable analytic ansatz.
b) After one day, the pressure has dropped by $\Delta p = 1$ MPa. Determine the exponential time constant τ. τ is the time after which the pressure has dropped to the $1/\mathrm{e}^{\mathrm{th}}$ part.

5)
Karl checks the pressure of his tires on a sunny day. He measures 2 bar at a temperature of 30°C. What is the pressure if the temperature drops to -10°C over night?