Interesting problems on air and pressure,

# 1 Energy in the Sauna

Determine how/if the thermal energy of the air in a Sauna changes when the Sauna is warmed up. Also try to explain this in non-technical terms.

## 2 Density of the air

Use the ideal gas law to calculate the density of air at NTP (normal temperature and pressure) which is defined by NIST (National Institute of Standards and Technology) to be a temperature of 20°C and an absolute pressure of 1 atm (101.325 kPa). Take the Oxygen content to be  $\approx 21\%$  and assume for simplicity that the rest is Nitrogen.

## 3 Humid air

What has higher density, dry or humid air?

## 4 Hot air balloon

Calculate the diameter of a spherical balloon (to make it simple) that can lift 1000 kg. Use the density of air calculated above as a main starting point. Assume that the ambient air is at 20°C and that the hot air in the balloon can be 50°C warmer.

#### 5 Pressure in water

At what depth under water is the pressure twice as big as it is on the surface?

# 6 Air-tight building

Buildings and rooms are not air tight. We here nevertheless assume that a room actually is air tight and determine the increase of pressure that would follow as the temperature of the room increased from  $17^{\circ}$ C to  $27^{\circ}$ C, e.g. due to the sun shining in through a window. What would be the force on a window with an area of  $1m^2$ ? Would you expect it to break?