Air pressure

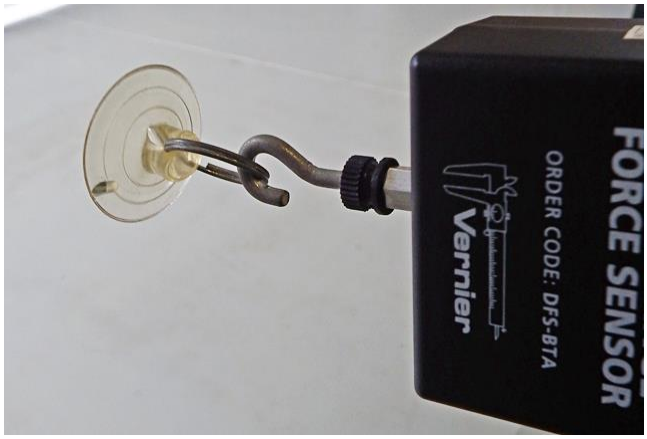
Introduction

Scientific arguments about whether air had weight and exerted pressure took place in Italy in the seventeenth century. Now everyone (well almost everyone) has heard of air pressure and many people know that the density of air at sea level is about 1.2 kg per cubic meter.

If you happen to be in a high-rise building or (as I once was in the South Pacific with students who could climb coconut trees) air pressure can be estimated by tightly closing one end of 10+ metres of aquarium hose coiled in a bucket of water. Lifting the closed end until a near vacuum appears above the upper water surface and measuring the height of the water column supported by air pressure. To get a better value you could use triple-boiled water (without dissolved air) and look up the vapour pressure of water at the temperature on the day, but we are demonstrating principles here, not working for the Bureau of Weights and Measures. If you're in a school somewhere that has half a kilogram of mercury you could do it that way, but most of us have to think of something else.

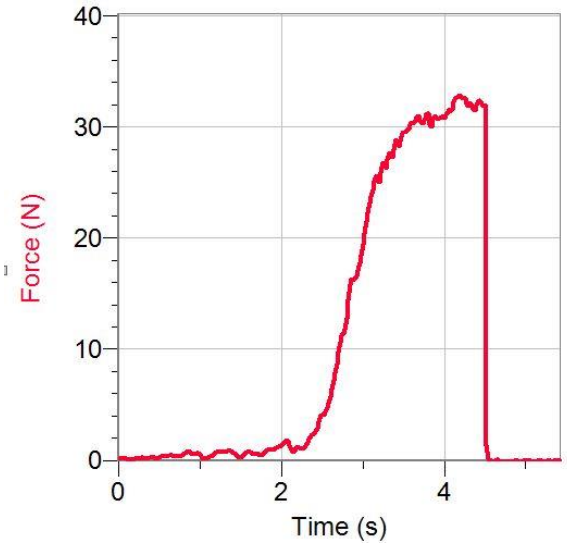
An air pressure demonstration

We do a quick semi-quantitative demonstration of air pressure with a small pressure cup (avoid calling it a suction cup: *suction* is not a useful concept in physics). Wet the cup, force it onto a window and pull it off with a force probe.

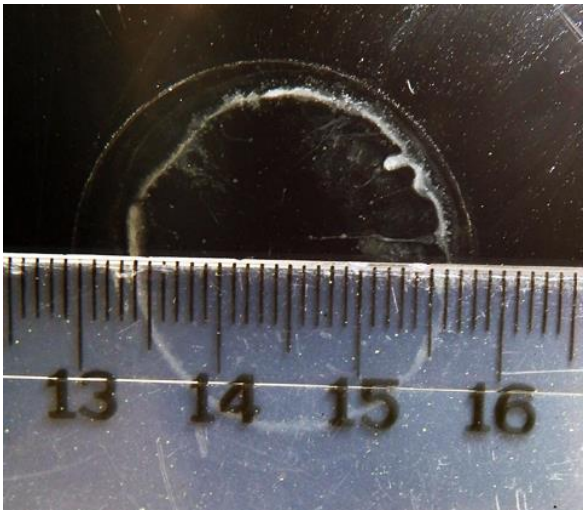


Select a cup in good condition that is small enough not to exceed the 50 N maximum reading of the force probe. The cup will contract slightly and leave a water mark on the window. Use the diameter of the ring to estimate the area.

A force/time graph in Logger Pro



The circular water mark on the window.



$P = F/A$

$= 33 \times (3.14 \times 1.15^2 \times 10^{-4})$

$= 80$ kPa

The result is of the right order of magnitude but lower than the known value (100 kPa) by some 20%, due in part to a small amount of residual air under the cup and an imperfect seal.