Practical 3 – Topic 3

The pressure/radius relation for a rubber balloon

Criteria assessed

- DCP
- CE

Materials needed

- Rubber balloon (spherical)
- Pressure gauge – preferably a pressure sensor, such as the one from Pasco (which comes with a syringe that can also be used for Boyle's law experiments), but if this not available then the pressure gauge of a bicycle pump may do the job
- Two-hole stopper
- Suction flask
- Ruler

In this experiment you need to measure the pressure inside an ordinary spherical balloon as it is being (slowly) inflated. For every recorded pressure of the balloon, measure the corresponding radius. It is unlikely that the balloon will be exactly spherical. You may want to measure two mutually perpendicular lengths L_1 and L_2 and call the radius $R = \frac{L_1 + L_2}{2}$ or $R = \sqrt{L_1 L_2}$.

You must connect the balloon to the side arm of the flask and secure it by tying it or taping it to the arm. Put the two-hole stopper in the mouth of the flask and make sure this is a tight fit. Attach the pressure gauge to one hole of the stopper and the bicycle pump to the other hole. (You will probably need to attach a bicycle valve to the hole before you will be able to connect to the pump.)

- Measure the pressure of the balloon as you pump it up.
- Measure the radius of the balloon at various pressures.
- How is the pressure P related to the radius R or the volume V of the balloon?
- In what ways is the pressure/volume curve different from an isothermal curve?

You may want to extend this investigation to non-spherical balloons and see how the pressure varies with the inflated length L of a cylindrical balloon.