Measurement of air pressure in balloon

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Abstract: When we blow birthday balloons, we know that air inside the balloons is at higher pressure than atmospheric pressure. This is also evident from the fact that when air gets opportunity to escape it leaves violently, making an explosive sound or if allowed to leave gradually, the balloon can fly off in air, the childhood experiences of all. This experiment aims at measuring the air pressure inside given balloon, approximately, using normally-available classroom equipment.

Equipment: 1 / measuring cylinder a bucket which can hold the fully-blown balloon completely, a tray in which this bucket can be placed conveniently, sufficient quantity of water to fill the bucket completely. A locking pin/clip to block air, a small radius soft tube, about 30 cm long.

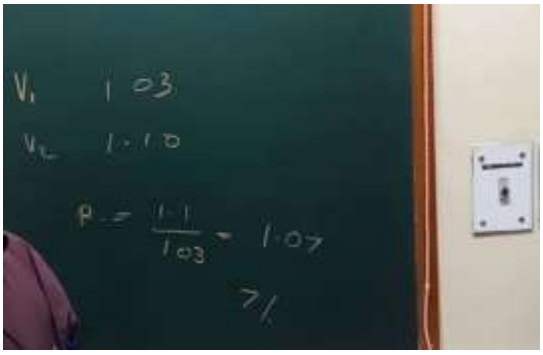
Procedure:

1. Fill the balloon with air, quickly insert the thin plastic tube into the mouth of the balloon and attach the clip so that air does not escape from balloon, even at a slow rate.
2. Fill the bucket completely with water, up to the brim, and insert the open end of tube in the water to check for slow rate leakages, if any. [Teachers have to ensure that water is filled upto the brim of the bucket. Any gaps left at this stage will make wrong measurement of V_c.]
3. Place the bucket filled with water on the empty tray. Slowly insert the balloon in the water and allow the overflowing water into the tray. Push the balloon down into water such that it is fully immersed. [The teacher should ensure that balloon is fully immersed in water.]
4. The volume of water collected in the tray, V_c, can be measured using the measuring cylinder. Vc is the volume of the compressed air inside the balloon. The air inside the balloon has pressure P_c.
5. Now fill the measuring cylinder with water up to the brim and insert it inside the tray filled with water, so that water does not spill out of the cylinder.
6. Insert the open end of the tube, attached to the balloon, into the cylinder and slowly release the air into the cylinder by loosening the clip.
7. In case the water is completely removed from the cylinder, stop the air flow using the clip and refill the cylinder with water. [Teachers should ensure that when volume is measured in multiple steps, no air escapes from balloon, directly into air. It should be released only into the water.]

8. It should be ensured that air from the balloon is completely released into water.

9. After repeating the process as many time as possible, release all the air inside the cylinder, displacing the water. The total volume of water displaced is the total volume of air inside the balloon, at atmospheric pressure, V_a and pressure P_a.
10. Using the pressure volume relation $P_a V_a = P_c V_c$. Since P_a is 1, the atmospheric pressure, air pressure in the balloon can be measured.

Note: It has been experienced but can be verified by teachers/students that the experiment does not give accurate result when balloon is not blown fully.


V1 1·03
V2 1·10
ρ = 1·1 / 1·03 = 1·07