

OCR A Physics A-Level

PAG 8.2

Investigating the relationship between pressure and
volume



Equipment

- Clamp stand
- 100 g masses and a mass holder
- String
- Syringe
- Tubing which fits tightly on the nozzle of the syringe
- Pinch clip
- Vernier calipers

Method

1. Take the plunger out of the syringe. Measure the syringe's internal diameter using vernier calipers and record this value.
2. Place the plunger back into the syringe and draw in 5 cm³ of air.
3. Without moving the plunger at all, place the tubing over the nozzle of the syringe and pinch it shut using the pinch clip. Make sure that the pinch clip is as close to the nozzle as possible.
4. Set up the clamp stand and attach the syringe to it so that the plunger is pointing downwards, leaving quite a bit of space below the syringe.
5. Attach the string to the end of the plunger, leaving a loop. Then, attach the 100 g mass holder to this loop.
6. Record the volume recorded by the syringe.
7. Add a 100 g mass to the holder and record the volume.
8. Repeat the above step until the total mass is 1000 g.
9. Repeat the whole procedure twice more and calculate the mean values of volume.

Calculations

- Calculate the cross-sectional area of the syringe in metres using the following equation:

$$A = \frac{\pi d^2}{4}$$

- Calculate the force exerted by each of the recorded masses by calculating their weight:

$$\text{Weight} = m \times g$$

Where m is the mass and g is the gravitational field strength, 9.81 Nkg⁻¹.

- Using the equation $P = F/A$, calculate the total pressure exerted on the gas at each value of force exerted.
- Total pressure is the sum of the pressure of the air sample and atmospheric pressure, therefore to find the pressure of the air sample you must subtract the atmospheric pressure (101 kPa) from your calculated values.
- Plot a graph of $1/V$ against the pressure of the air sample and draw a line of best fit.

Safety

- Be careful when handling masses - if dropped they may cause injury.
- If the clamp stand is unstable, a counterweight placed on the base of the clamp stand can be used to prevent it from falling over. Alternatively it can be clamped to the bench with a G-clamp.



Notes

- Your line of best fit should form a straight line through the origin showing that $1/V$ and the pressure of the air sample are directly proportional or, that V and the pressure of the air sample are inversely proportional.

