TAP 601- 4: Changes in volume, changes in pressure

Common behaviour

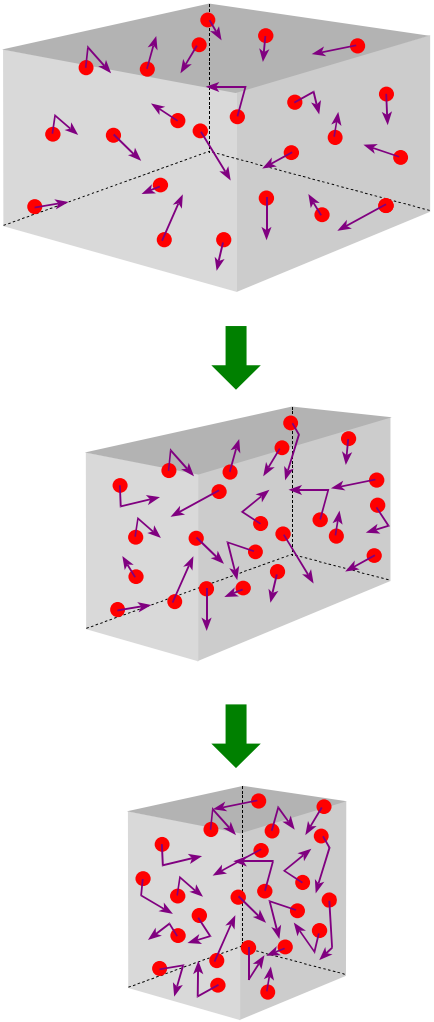
Gases are remarkable because they are all so similar. Solids vary considerably because their particles are tightly bound together, and the details of the bonding affect the properties of the material. Gas particles are not tightly bound and spend most of their time not interacting with other particles, so are much simpler. Once you know the mass and speed of the particles that make up the gas, you know enough to be able to predict some macroscopic properties of the gas.

Here you look at how packing more and more gas into a given volume affects the pressure. Precisely because all gases behave in very similar ways, you do not need to worry about which gas you use.

You will need

- ✓ Boyle's law apparatus

Thinking about the measurements

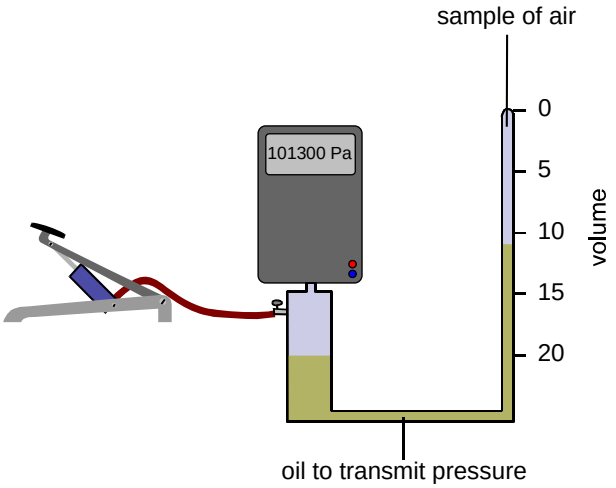


You need to measure how the volume of a fixed number of particles affects the pressure. Squeezing these particles into a smaller and smaller volume results in more and more

collisions with the walls, giving a higher pressure. However, you will only get a true relationship between pressure and volume if the number of particles stays the same: you need to make sure that no molecules escape. Rough and ready results can be obtained by using syringes, but these leak, so more precise ways have evolved – sealing off a volume of gas behind a liquid makes for a good seal. It is the measurement of volume that turns out to be the difficult one to get right. You may be able to set up a slicker arrangement using automated data capture, but you will need to take great care to measure the volume, ensuring the equivalent of a leak-proof syringe, where you can measure the position of the plunger or piston.

Compressing a gas will warm it up and vice versa, so after changing the volume leave sufficient time for the temperature to return to its original value.

A traditional solution



1. Take readings of pressure and volume for a suitable range of volumes, determined after a pre-test. Plot a graph as you go.
2. Look for a pattern in the results and then plot a presentation graph, showing the pattern clearly.
3. Are there any regions of the graph that do not fit your pattern as well? Can you account for these deviations in ways that relate back to the state of the gas at that point – or other likely weaknesses in the experimental arrangement?

You have

1. Measured how the volume of a gas changes with its pressure.
2. Thought carefully about why the experiment is set up in a particular way.
3. Produced a set of presentation-quality graphs describing the relationships you found.

Practical advice

This is a straightforward and well known experiment – but it is important that students think through the reasons why the experiment came to be in this form – and consider what could be done to modernise it.

External reference

This activity is taken from Advancing Physics chapter 13, 20E