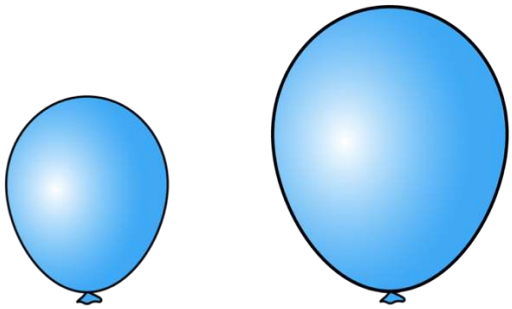
0 1

Nadia is investigating how the pressure of a gas is affected by its temperature. She places a balloon into a freezer for one hour.

When she took it out of the freezer, she noticed that its volume had decreased. She then set it on a table. After a few minutes, it had returned to its original size, as shown below.



Out of freezer Room temperature

0 1 . 1

Describe the arrangement and motion of the particles in a gas.

The particles in a gas are spaced widely,
they move randomly,
and there are (very) weak forces of attraction between them.

Any TWO.

0 1 . 2

Using ideas about particles and pressure, explain why the volume of the balloon had decreased when it was taken out of the freezer.

The moment the balloon was placed into the freezer, the air inside it would have been at a higher temperature than the air inside the freezer [1]. This would have caused thermal (heat) energy to flow from the air in the balloon to the air in the freezer and the temperature of the air inside the balloon would have decreased (until it had reached the operating temperature of the freezer) [1].

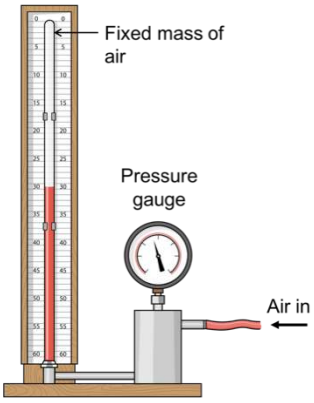
This means that the kinetic energy of the air particles inside the balloon would have decreased [1]. As the particles would then have been moving more slowly, the amount of pressure they would exert on the inside surface of the balloon would decrease (they would strike the inside surface less frequently, and with less force each time they did so) [1].

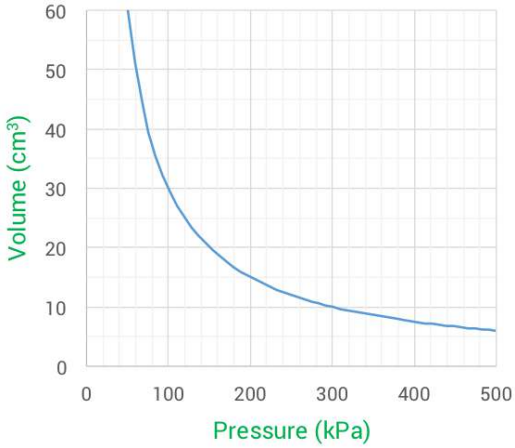
When the pressure inside the balloon is lower than the pressure outside it, there would be a force exerted on it which would cause it to shrink in size (this process would continue until the pressures inside and outside the balloon were equal) [1].

Any FOUR.

0 2

A teacher uses a foot pump to increase the pressure applied to a fixed mass of air. The experimental setup used, and the data obtained, are shown below.





0 2 . 1

State the independent variable in their investigation.

Pressure.

Remember that the independent variable is the variable we *change* in an investigation.
Here, the teacher is increasing the pressure, and is seeing how that affects the volume of air (so volume is the *dependent variable*).

0 2 . 2

Use the above experimental data to prove the following relationship for this fixed mass of air:

p V = constant

For this question, calculate p × V for any two points and compare, for example:

For the point (100, 30): 100 × 30 = 3000
For the point (300, 10): 300 × 10 = 3000

Hence p × V = constant

0 2 . 3

Estimate what the volume of air would have been had the pressure been increased to 600 kPa.

p × V = constant
600 × V = 3000 (from previous question)
V = 3000 ÷ 600 = **5 cm^3**

OR because V is inversely proportional to p, when p is doubled, V will half.
When p = 300, V = 10, so when p = 600, V = 5 cm^3.