

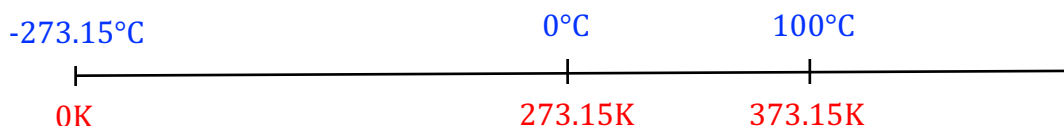
6.5.2 Temperature scales

We are most familiar with measuring temperature in degrees Celsius. This is a scale based on changes that occur to H_2O at two points – the melting point and the boiling point (at standard temperature and pressure). The scale is divided into 100 intervals between these two points.



A more fundamental temperature scale is one which goes to zero at the point when the internal energy reaches a minimum – absolute zero. This is known as an absolute temperature scale. The Kelvin scale is an absolute scale. It is a scale based on two fixed points – absolute zero and the triple point of water (which is the temperature at which ice, water and water vapour are in thermal equilibrium. It has (to a very close approximation) the same temperature interval as the Celsius scale, but goes to zero at absolute zero.

celcius scale



kelvin scale

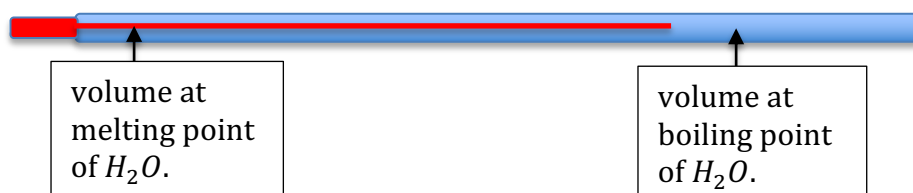
(1) ✎ What are the following temperatures in kelvin (K)? i) -77°C , ii) -230°C , iii) 3200°C

(2) ✎ What are the following temperatures in degrees Celsius ($^{\circ}\text{C}$)? i) 300K , ii) 35K , iii) 3000K

Thermometers

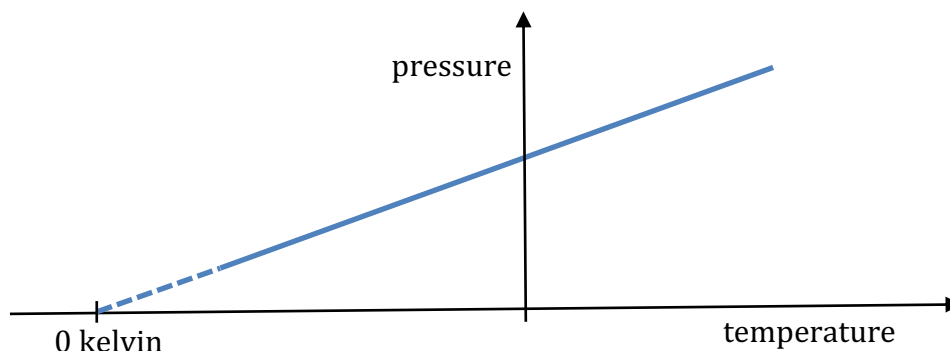
Mercury and alcohol thermometers use the expansion of liquids to measure the temperature. When the liquids expand, liquid is forced up a thin tube. The height of the liquid in the tube is a measure of temperature.

To calibrate this type of thermometer, a least two fixed points are required. For example – the melting and boiling point of H_2O . Equal divisions are made between these fixed points to produce a scale in between.



(3) ✎ What assumption is made about the expansion of the liquid between these two fixed points?

An absolute temperature scale can be determined based on a physical property of a material that changes in proportion to the mean kinetic energy on the constituent molecules. For example, the pressure in a diffuse gas in a sealed container (with constant volume), will behave linearly:



The pressure will extrapolate to zero at 0 kelvin. To calibrate this 'constant-volume gas pressure thermometer', the gas pressure can be measured at a particular temperature (e.g. the melting point of H_2O). Assuming that the gas pressure (P) behaves linearly we can link the temperature (T) to the pressure:

$$T = \text{constant} \times P$$

(4) ✎ The pressure of a constant-volume gas thermometer was 100kPa at a temperature of 273K. Calculate the temperature, in kelvin, of the gas when its pressure is 150kPa.

No 'real' gas is perfect. An idealised gas, called an 'ideal gas' is one in which the pressure of a fixed volume of gas is directly proportional to the mean kinetic energy of the constituent particles.