Ideal gases

(Ideal gas constant (R) = 8.3 mol-1 K-1)

1. Calculate the number of moles of a gas of pressure 105 Pa at a temperature of 27°C occupying a volume of 5 m3.

2. An ideal gas has a molar mass of 40 g and a density of 1.2 kg m-3 at 80 °C. What is its pressure at that temperature?

3. An ideal gas is contained in a metal cylinder with a volume of 0.25 m3 at a pressure of 15 x 105 Pa and a temperature of 20 °C. If the gas is allowed to expand into the atmosphere at a pressure of 105 Pa and a temperature of 15 °C what is its new volume?

Using the ideal gas relationships

These are exercises to allow you to gain confidence in using the ideal gas law:

PV = nRT. The molar gas constant (R = NA k) is 8.31 J mol–1 K–1.

Try these

A 5 mol sample of nitrogen exerts a pressure of 150 000 Pa at a temperature of 373 K.

1. What is the volume of this sample?

2. The temperature is changed to 273 K and the pressure drops to 100 000 Pa. What is the volume now?

A sample of gas with a pressure of 100 000 Pa has a volume of 5 litres at a temperature of 7 C. The pressure now drops to 80 000 Pa and the temperature increases by 40 C.

3. Calculate the new volume.

The atmospheric pressure is about 100 000 Pa and the temperature about 300 K.

4. Estimate the number of moles of air in the room you are in now.

The molar mass of carbon dioxide is 0.045 kg mol–1.

5. Calculate the density of the gas when the temperature is 273 K and the pressure is

120 000 Pa.

The summit of Mount Everest can be at a temperature of – 50 C and the pressure at its summit is roughly one-third that at sea level. The density of air in your laboratory is about 1.25 kg m–3.

6. Calculate the density of air at the top of the mountain.

Hints. *Mount Everest: calculate the molar volume at both sets of conditions; these volumes will hold the same number of molecules. Use the ratio to calculate the density at the top of the mountain.*