Answer on Question #45009 – Physics – Molecular Physics|Thermodynamics

Question.

Find the initial temperature in K of a gas if the final temperature is 500 degrees Celsius and is expanded adiabatically by a pressure ration of 11:1 the adiabatic index is 1.38.

$T_2 = 500℃ = 773\ K$

$\frac{P_1}{P_2} = \frac{11}{1} = 11$

$\gamma = 1.38$

$T_1 = ?$

Solution.

The adiabatic equation:

$$PV^\gamma = const$$

But from the equation of ideal gas we know

$$PV = RT \to \frac{PV}{T} = R = const \to V = \frac{const}{P}T$$

Therefore,

$$P^{1-\gamma}T^\gamma = const$$

In our case,

$$P_1^{1-\gamma}T_1^\gamma = P_2^{1-\gamma}T_2^\gamma = const \to \left(\frac{T_1}{T_2}\right)^\gamma = \left(\frac{P_2}{P_1}\right)^{1-\gamma}$$

So,

$$T_1 = T_2\left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}$$

Calculate:

$$T_1 = 773 \cdot 11^{0.275} = 773 \cdot 1.934 = 1495\ K$$

Answer.

$$T_1 = T_2\left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}} = 1495\ K$$