Example

To show:

$$\frac{T_i}{T_f} = \left(\frac{V_f}{V_i}\right)^{\gamma - 1}$$

Given: Adiabatic Change of an Ideal Gas

$$P_i V_i^{\gamma} = P_f V_f^{\gamma} \qquad \frac{P_i V_i}{T_i} = \frac{P_f V_f}{T_f}$$

$$\downarrow \qquad \downarrow$$

$$P_i = P_f \left(\frac{V_f^{\gamma}}{V_i^{\gamma}}\right) \longrightarrow P_i \left(\frac{V_f}{T_i}\right) = P_f \left(\frac{V_f}{V_i}\right)$$

$$\downarrow$$

$$\cancel{P_f} \left(\frac{V_f^{\gamma}}{V_i^{\gamma}}\right) \frac{T_f}{T_i} = \cancel{P_f} \frac{V_f}{V_i}$$

$$\frac{T_f}{T_i} = \frac{\left(\frac{V_f}{V_i}\right)^1}{\left(\frac{V_f}{V_i}\right)^{\gamma}}$$

$$\frac{T_i}{T_f} = \frac{\left(\frac{V_f}{V_i}\right)^{\gamma}}{\left(\frac{V_f}{V_i}\right)^{1}} = \left(\frac{V_f}{V_i}\right)^{\gamma-1}$$

$$\frac{T_i}{T_f} = \left(\frac{V_f}{V_i}\right)^{\gamma-1} \quad \therefore$$

Method 2

Given

$$P_i V_i^{\gamma} = P_f V_f^{\gamma}$$

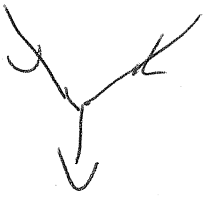
$$\downarrow$$

$$\frac{P_i}{P_f} = \left(\frac{V_f}{V_i}\right)^{\gamma}$$

$$\frac{P_i V_i}{T_i} = \frac{P_f V_f}{T_f}$$

$$\downarrow$$

$$\left(\frac{P_i}{P_f}\right)\left(\frac{V_i}{V_f}\right) = \frac{T_i}{T_f}$$



$$\left(\frac{V_f}{V_i}\right)^{\gamma}\left(\frac{V_i}{V_f}\right) = \frac{T_i}{T_f} = \left(\frac{V_f}{V_i}\right)^{-1}\left(\frac{V_f}{V_i}\right)^{\gamma} = \left(\frac{V_f}{V_i}\right)^{\gamma-1}$$

$$\frac{T_i}{T_f} = \left(\frac{V_f}{V_i}\right)^{\gamma-1} \quad \therefore$$