Partial differentiation

1 The pressure and volume of an ideal gas undergoing an adiabatic change obey the rule:

$$PV^{\gamma} = k$$

where γ and k are constants for the given gas. If, during an adiabatic change, the pressures are plotted against the corresponding volumes show that the slope of the graph is given as:

$$\frac{\mathrm{d}P}{\mathrm{d}V} = -\gamma\frac{P}{V}$$

Working

1 $PV^{\gamma} = k$ and so $P = kV^{-\gamma}$. Consequently

$$\begin{aligned}\frac{\mathrm{d}P}{\mathrm{d}V} &= \frac{\mathrm{d}kV^{-\gamma}}{\mathrm{d}V}\\ &= -k\gamma V^{-\gamma-1}\\ &= -\gamma(kV^{-\gamma})V^{-1}\\ &= -\gamma\frac{P}{V}\end{aligned}$$