

Answer on Question#48361 - Chemistry - Physical Chemistry

The temperature(T) of an ideal gas varies with it's volume (V) as $T = -aV^3 + bV^2$. where a and b are positive constant s. the maximum pressure of gas during this process is.

Answer:

P, V and T are connected by Clapeyrone's law (ideal gas law):

$$PV = \frac{m}{M} RT \quad (1),$$

where P - gas pressure, V - gas volume, T - gas temperature, R - universal gas constant, m - mass of the gas, M - molar mas of the gas.

From (1):

$$P = \frac{mR}{M} \frac{T}{V}$$

$$P = \frac{mR}{M} \frac{(-aV^3 + bV^2)}{V} = \frac{mR}{M} (-aV^2 + bV)$$

P is maximal when it's first derivative is equal to 0.

$$P'(V) = \frac{mR}{M} (-2aV + b) = 0$$

$$V = \frac{b}{2a}$$

Thus, maximal P is:

$$P = \frac{mR}{M} (-aV^2 + bV) = \frac{mR}{M} \left(\frac{-b^2}{4a} + \frac{b^2}{2a} \right) = \frac{mR}{M} \frac{b^2}{4a} = \frac{mRs}{4M}$$

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