Answer on Question 57145, Physics, Molecular Physics | Thermodynamics

Question:

An ideal gas is expanding such that $PT = const$. The coefficient of volume expansion of the gas is

a) $1/T$

b) $2/T$

c) $3/T$

d) $4/T$

Solution:

We can find the coefficient of volume expansion of the gas from the formula:

$$\gamma = \frac{1}{V}\frac{dV}{dT}.$$

Let's write the ideal gas law:

$$PV = nRT.$$

From this formula we can find P:

$$P = \frac{nRT}{V}.$$

Therefore, substituting P into the formula $PT = const$ we get:

$$\frac{nRT}{V}T = const,$$

$$nRT^2 = const \cdot V.$$

Let's differentiate the last equation:

$$2nRTdT = const \cdot dV,$$

$$\frac{dV}{dT} = \frac{2nRT}{const}.$$

Then, we can find the coefficient of volume expansion (from the ideal gas law we obtain $V = \frac{nRT}{P}$ and $PT = const$):

$$\gamma = \frac{1}{V}\frac{dV}{dT} = \frac{2nRT}{const \cdot V} = \frac{2nRT}{PT \cdot \frac{nRT}{P}} = \frac{2}{T}.$$

Answer:

b) $\gamma = 2/T$.