coefficient of isothermal compressibility using the equation of state for an ideal gas

none

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Abstract

Generated by the Physics Derivation Graph. https://notendur.hi.is/hj/EE2/HD1lausn.pdf

Eq. 1 is an initial equation.

$$\kappa_T = \frac{-1}{V}\left(\frac{\partial V}{\partial P}\right)_T \tag{1}$$

Eq. 2 is an initial equation.

$$PV = nRT \tag{2}$$

Divide both sides of Eq. 2 by P; yields Eq. 3.

$$V = \frac{nRT}{P} \tag{3}$$

Substitute LHS of Eq. 3 into Eq. 1; yields Eq. 4.

$$\kappa_T = \frac{-1}{V}\left(\frac{\partial}{\partial P}\left(\frac{nRT}{P}\right)\right)_T \tag{4}$$

Simplify Eq. 4; yields Eq. 5.

$$\kappa_T = \frac{-nRT}{V}\left(\frac{\partial}{\partial P}\left(\frac{1}{P}\right)\right)_T \tag{5}$$

Simplify Eq. 5; yields Eq. 6.

$$\kappa_T = \frac{-nRT}{V}\left(\frac{-1}{P^2}\right) \tag{6}$$

Substitute LHS of Eq. 2 into Eq. 6; yields Eq. 7.

$$\kappa_T = \frac{-PV}{V}\left(\frac{-1}{P^2}\right) \tag{7}$$

Simplify Eq. 7; yields Eq. 8.

$$\kappa_T = \frac{1}{P} \tag{8}$$

Eq. 8 is one of the final equations.

References