

# Important Formulae on Clausius Model of Real Gas Formulas PDF



## Formulas Examples with Units

### List of 19 Important Formulae on Clausius Model of Real Gas Formulas

#### 1) Actual Pressure of Real Gas given Clausius Parameter a, Reduced and Critical Parameters

Formula

Formula

$$P_a = \left( \frac{27 \cdot ([R]^2) \cdot (T'_c)^3}{64 \cdot a} \right) \cdot P_r$$

Example with Units

$$8.6E+8 \text{ Pa} = \left( \frac{27 \cdot (8.3145^2) \cdot (154.4 \text{ K})^3}{64 \cdot 0.1} \right) \cdot 0.8$$

Evaluate Formula

#### 2) Actual Pressure of Real Gas given Clausius Parameter b, Reduced and Actual Parameters

Formula

Formula

$$P_b = \left( \frac{[R] \cdot \left( \frac{T_{rg}}{T_r} \right)}{4 \cdot \left( \left( \frac{V_{real}}{V_r} \right) - b' \right)} \right) \cdot P_r$$

Example with Units

$$21.5646 \text{ Pa} = \left( \frac{8.3145 \cdot \left( \frac{300 \text{ K}}{10} \right)}{4 \cdot \left( \left( \frac{22 \text{ L}}{9.5 \text{ L}} \right) - 2.43E-3 \right)} \right) \cdot 0.8$$

Evaluate Formula

#### 3) Actual Pressure of Real Gas given Clausius Parameter c, Reduced and Actual Parameters

Formula

Formula

$$P_c = \left( \frac{3 \cdot [R] \cdot \left( \frac{T_{rg}}{T_r} \right)}{8 \cdot \left( c + \left( \frac{V_{real}}{V_r} \right) \right)} \right) \cdot P_r$$

Example with Units

$$32.3102 \text{ Pa} = \left( \frac{3 \cdot 8.3145 \cdot \left( \frac{300 \text{ K}}{10} \right)}{8 \cdot \left( 0.0002 + \left( \frac{22 \text{ L}}{9.5 \text{ L}} \right) \right)} \right) \cdot 0.8$$

Evaluate Formula

#### 4) Actual Temperature of Real Gas given Clausius Parameter a, Reduced and Actual Parameters

Formula

Formula

$$T_{RP} = \left( \frac{a \cdot 64 \cdot \left( \frac{p}{P_r} \right)^{\frac{1}{3}}}{27 \cdot ([R]^2)} \right) \cdot T_r$$

Example with Units

$$15.0793 \text{ K} = \left( \frac{0.1 \cdot 64 \cdot \left( \frac{800 \text{ Pa}}{0.8} \right)^{\frac{1}{3}}}{27 \cdot (8.3145^2)} \right) \cdot 10$$

Evaluate Formula



## 5) Actual Temperature of Real Gas using Critical and Reduced Temperature Formula

Formula

$$T_{RT} = T_r \cdot T'_c$$

Example with Units

$$1544 \text{ K} = 10 \cdot 154.4 \text{ K}$$

Evaluate Formula 

## 6) Actual Volume of Real Gas using Clausius Parameter b, Reduced and Critical Parameters Formula

Formula

$$V_{\text{real\_CP}} = \left( b' + \left( \frac{[R] \cdot T'_c}{4 \cdot P'_c} \right) \right) \cdot V_r$$

Example with Units

$$0.0237 \text{ L} = \left( 2.43\text{E-}3 + \left( \frac{8.3145 \cdot 154.4 \text{ K}}{4 \cdot 4.6\text{E+}6 \text{ Pa}} \right) \right) \cdot 9.5 \text{ L}$$

Evaluate Formula 

## 7) Actual Volume of Real Gas using Clausius Parameter c, Reduced and Critical Parameters Formula

Formula

$$V_{\text{real\_CP}} = \left( \left( \frac{3 \cdot [R] \cdot T_c}{8 \cdot P'_c} \right) - c \right) \cdot V'_{m,r}$$

Example with Units

$$2.1373 \text{ L} = \left( \left( \frac{3 \cdot 8.3145 \cdot 647 \text{ K}}{8 \cdot 4.6\text{E+}6 \text{ Pa}} \right) - 0.0002 \right) \cdot 8.96$$

Evaluate Formula 

## 8) Clausius Parameter b given Reduced and Actual Parameters Formula

Formula

$$b_{RP} = \left( \frac{V_{\text{real}}}{V_r} \right) - \left( \frac{[R] \cdot \left( \frac{T_{rg}}{T_r} \right)}{4 \cdot \left( \frac{p}{P'_r} \right)} \right)$$

Example with Units

$$2.2534 = \left( \frac{22 \text{ L}}{9.5 \text{ L}} \right) - \left( \frac{8.3145 \cdot \left( \frac{300 \text{ K}}{10} \right)}{4 \cdot \left( \frac{800 \text{ Pa}}{0.8} \right)} \right)$$

Evaluate Formula 

## 9) Clausius Parameter c given Critical Parameters Formula

Formula

$$c_{CP} = \left( \frac{3 \cdot [R] \cdot T_c}{8 \cdot P_c} \right) - V_c$$

Example with Units

$$9.2437 = \left( \frac{3 \cdot 8.3145 \cdot 647 \text{ K}}{8 \cdot 218 \text{ Pa}} \right) - 10 \text{ L}$$

Evaluate Formula 

## 10) Critical Molar Volume of Real Gas using Clausius Equation given Reduced and Actual Parameters Formula

Formula

$$V_{RP} = \frac{\left( \frac{[R] \cdot T_{rg}}{p + \left( \frac{a}{T_{rg}} \right)} \right) + b'}{V'_{m,r}}$$

Example with Units

$$0.3483 \text{ m}^3/\text{mol} = \frac{\left( \frac{8.3145 \cdot 300 \text{ K}}{800 \text{ Pa} + \left( \frac{0.1}{300 \text{ K}} \right)} \right) + 2.43\text{E-}3}{8.96}$$

Evaluate Formula 



### 11) Critical Molar Volume using Clausius Equation given Actual and Critical Parameters Formula



Formula

$$V_{RP} = \frac{\left( \frac{[R] \cdot T_{rg}}{p + \left( \frac{a}{T_{rg}} \right)} \right) + b'}{V_m}$$

Example with Units

$$0.1393 \text{ m}^3/\text{mol} = \frac{\left( \frac{8.3145 \cdot 300 \text{ K}}{800 \text{ Pa} + \left( \frac{0.1}{300 \text{ K}} \right)} \right) + 2.43\text{E-}3}{22.4 \text{ m}^3/\text{mol}}$$

Evaluate Formula

### 12) Critical Pressure of Real Gas using Actual and Reduced Pressure Formula



Formula

$$P_{CP} = \frac{p}{P_r}$$

Example with Units

$$1000 \text{ Pa} = \frac{800 \text{ Pa}}{0.8}$$

Evaluate Formula

### 13) Critical Temperature given Clausius Parameter c, Reduced and Actual Parameters Formula



Formula

$$T_{c\_RP} = \frac{\left( c + \left( \frac{V_{real}}{V_r} \right) \right) \cdot 8 \cdot \left( \frac{p}{P_r} \right)}{3 \cdot [R]}$$

Example with Units

$$742.7987 \text{ K} = \frac{\left( 0.0002 + \left( \frac{22 \text{ L}}{9.5 \text{ L}} \right) \right) \cdot 8 \cdot \left( \frac{800 \text{ Pa}}{0.8} \right)}{3 \cdot 8.3145}$$

Evaluate Formula

### 14) Molar Volume of Real Gas using Clausius Equation Formula



Formula

$$V_{m\_CE} = \left( \frac{[R] \cdot T_{rg}}{p + \left( \frac{a}{T_{rg}} \right)} \right) + b'$$

Example with Units

$$3.1204 \text{ m}^3/\text{mol} = \left( \frac{8.3145 \cdot 300 \text{ K}}{800 \text{ Pa} + \left( \frac{0.1}{300 \text{ K}} \right)} \right) + 2.43\text{E-}3$$

Evaluate Formula

### 15) Reduced Pressure of Real Gas using Actual and Critical Pressure Formula



Formula

$$P_{r\_AP\_RP} = \frac{P_{rg}}{P'_c}$$

Example with Units

$$0.0022 = \frac{10132 \text{ Pa}}{4.6\text{E}+6 \text{ Pa}}$$

Evaluate Formula



## 16) Reduced Temperature of Real Gas using Clausius Equation given Reduced and Actual Parameters Formula

Evaluate Formula 

Formula

$$T_{r\_RP\_AP} = \frac{\left( p + \left( \frac{a}{\left( (V_m + c)^2 \right)} \right) \right) \cdot \left( \frac{V_m - b'}{[R]} \right)}{T_{rg}}$$

Example with Units

$$7.1835 = \frac{\left( 800 \text{ Pa} + \left( \frac{0.1}{\left( (22.4 \text{ m}^3/\text{mol} + 0.0002)^2 \right)} \right) \right) \cdot \left( \frac{22.4 \text{ m}^3/\text{mol} - 2.43\text{E-}3}{8.3145} \right)}{300 \text{ K}}$$

## 17) Reduced Volume of Real Gas given Clausius Parameter c, Reduced and Actual Parameters Formula

Evaluate Formula 

Formula

$$V_{r\_RP\_AP} = \frac{V_{real}}{\left( \frac{3 \cdot [R] \cdot \left( \frac{T_{real}}{T_r} \right)}{8 \cdot \left( \frac{P_{real}}{P_r} \right)} \right) - c}$$

Example with Units

$$0.0297 = \frac{22 \text{ L}}{\left( \frac{3 \cdot 8.3145 \cdot \left( \frac{300 \text{ K}}{10} \right)}{8 \cdot \left( \frac{101 \text{ Pa}}{0.8} \right)} \right) - 0.0002}$$

## 18) Temperature of Real Gas using Clausius Equation Formula

Evaluate Formula 

Formula

$$T_{CE} = \left( p + \left( \frac{a}{\left( (V_m + c)^2 \right)} \right) \right) \cdot \left( \frac{V_m - b'}{[R]} \right)$$

Example with Units

$$2155.0473 \text{ K} = \left( 800 \text{ Pa} + \left( \frac{0.1}{\left( (22.4 \text{ m}^3/\text{mol} + 0.0002)^2 \right)} \right) \right) \cdot \left( \frac{22.4 \text{ m}^3/\text{mol} - 2.43\text{E-}3}{8.3145} \right)$$



## 19) Temperature of Real Gas using Clausius Equation given Reduced and Critical Parameters

### Formula

Formula

Evaluate Formula 

$$T_{CE} = \left( \left( P_r \cdot P'_c \right) + \left( \frac{a}{\left( \left( \left( V'_{m,r} \cdot V_{m,c} \right) + c \right)^2 \right)} \right) \right) \cdot \left( \frac{\left( V'_{m,r} \cdot V_{m,c} \right) - b'}{[R]} \right)$$

Example with Units

$$4.6E+7_K = \left( \left( 0.8 \cdot 4.6E+6_{Pa} \right) + \left( \frac{0.1}{\left( \left( \left( 8.96 \cdot 11.5m^3/mol \right) + 0.0002 \right)^2 \right)} \right) \right) \cdot \left( \frac{\left( 8.96 \cdot 11.5m^3/mol \right) - 2.43E-3}{8.3145} \right)$$



## Variables used in list of Important Formulae on Clausius Model of Real Gas above

- **a** Clausius Parameter a
- **b'** Clausius Parameter b for Real Gas
- **b<sub>RP</sub>** Clausius Parameter b given RP
- **c** Clausius Parameter c
- **c<sub>CP</sub>** Clausius Parameter c given CP
- **p** Pressure (Pascal)
- **P<sub>c</sub>** Critical Pressure (Pascal)
- **P'<sub>c</sub>** Critical Pressure of Real Gas (Pascal)
- **P<sub>CP</sub>** Critical Pressure given RP (Pascal)
- **P<sub>r</sub>** Reduced Pressure
- **P<sub>r\_AP\_RP</sub>** Reduced Pressure given RP AP
- **P<sub>real</sub>** Real Gas Pressure (Pascal)
- **P<sub>rg</sub>** Pressure of Gas (Pascal)
- **P<sub>a</sub>** Pressure given a (Pascal)
- **P<sub>b</sub>** Pressure given b (Pascal)
- **P<sub>c</sub>** Pressure given c (Pascal)
- **T<sub>c</sub>** Critical Temperature (Kelvin)
- **T'<sub>c</sub>** Critical Temperature For Clausius Model (Kelvin)
- **T<sub>c\_RP</sub>** Critical temperature given RP (Kelvin)
- **T<sub>CE</sub>** Temperature given CE (Kelvin)
- **T<sub>r</sub>** Reduced Temperature
- **T<sub>r\_RP\_AP</sub>** Reduced Temperature given RP AP
- **T<sub>real</sub>** Real Gas Temperature (Kelvin)
- **T<sub>rg</sub>** Temperature of Real Gas (Kelvin)
- **T<sub>RP</sub>** Temperature given RP (Kelvin)
- **T<sub>RT</sub>** Temperature given RT (Kelvin)
- **V<sub>c</sub>** Critical Volume (Liter)
- **V<sub>m</sub>** Molar Volume (Cubic Meter per Mole)
- **V<sub>m,c</sub>** Critical Molar Volume (Cubic Meter per Mole)
- **V'<sub>m,r</sub>** Reduced Molar Volume for Real Gas
- **V<sub>m\_CE</sub>** Molar Volume given CE (Cubic Meter per Mole)

## Constants, Functions, Measurements used in list of Important Formulae on Clausius Model of Real Gas above

- **constant(s):** [R], 8.31446261815324  
*Universal gas constant*
- **Measurement: Temperature** in Kelvin (K)  
*Temperature Unit Conversion* ↻
- **Measurement: Volume** in Liter (L)  
*Volume Unit Conversion* ↻
- **Measurement: Pressure** in Pascal (Pa)  
*Pressure Unit Conversion* ↻
- **Measurement: Molar Magnetic Susceptibility** in Cubic Meter per Mole (m<sup>3</sup>/mol)  
*Molar Magnetic Susceptibility Unit Conversion* ↻



- $V_r$  Reduced Volume (*Liter*)
- $V_{r\_RP\_AP}$  Reduced Volume given RP AP
- $V_{real}$  Volume of Real Gas (*Liter*)
- $V_{real\_CP}$  Volume of Real Gas given CP (*Liter*)
- $V_{RP}$  Critical Molar Volume given RP (*Cubic Meter per Mole*)



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- **Important Actual Temperature of Real Gas Formulas** 
- **Important Actual Volume of Real Gas Formulas** 
- **Important Clausius Parameter Formulas** 
- **Important Critical Pressure Formulas** 
- **Important Critical Temperature Formulas** 
- **Important Reduced Pressure of Real Gas Formulas** 
- **Important Reduced Temperature of Real Gas Formulas** 
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