13η ΑΣΚΗΣΗ : αέριο : Α2ο ΤΟ - πραγματική $p = 2000\,(kPa)$

1) $pV = m R_1 T$, $R_1 = 297\ J/kg \cdot K$, $V = 3,27\,(m^3)$, $m = 100\,(kg)$

$T = 225\,(K)$

$p = 2043,577\ kPa$

σφάλμα: $\frac{2043,577 - 2000}{2000} \times 100 = 2,17\%$

2) Van der Waals

$T_{κρ} = 126,2\,(K)$ $P_{κρ} = 3,39\ MPa = 3390\ kPa$

Σταθερές: $a = \frac{27 \cdot R^2 \cdot T_{κρ}^2}{64 \cdot P_{κρ}} = 0,175\ \frac{m^6 \cdot kPa}{kg^2}$

$b = \frac{R \cdot T_{κρ}}{8 P_{κρ}} = 0,00138\ m^3/kg$

$v = \frac{V}{m} = 0,0327\ (m^3/kg)$

$p = \frac{RT}{v - b} - \frac{a}{v^2} = 1969,96\ kPa$

σφάλμα: $\frac{|1969,96 - 2000|}{2000} \times 100 = 1,5\%$

3. Beattie-Bridgeman

$$p = \frac{R_u \cdot T}{\bar{v}^2}\left(1 - \frac{c}{\bar{v} \cdot T^3}\right) \cdot \left(\bar{v} + B\right) - \frac{A}{\bar{v}^2}, \quad R_u = 8{,}314 \ \text{kJ/kmole·K}$$

$$A = A_0\left(1 - \frac{a}{\bar{v}}\right), \quad B = B_0\left(1 - \frac{b}{\bar{v}}\right)$$

$A_0 = 136{,}2315$, $B_0 = 0{,}05046$,

$a = 0{,}02617$, $b = -0{,}00691$, $c = 4{,}80 \times 10^4 \left(\frac{m^3 \cdot K^3}{kmole}\right)$

$\bar{v} = M \cdot v = 28 \frac{kg}{kmole} \times 0{,}0327 \frac{m^3}{kg} = 0{,}9156 \ m^3/kmole$

$A = 132{,}337 \qquad B = 0{,}05084$

$p = 1990 \ (kPa)$

Σφάλμα: $\left|\frac{1990 - 2000}{2000}\right| \times 100 = 0{,}5\%$

4. Benedict – Webb – Rubin

$$p = \frac{R_u \cdot T}{\bar{v}} + \left(B_0 \cdot R_u \cdot T - A_0 - \frac{C_0}{T^2}\right) + \frac{b \cdot R_u T - a}{\bar{v}^3} + \frac{a \cdot \alpha}{\bar{v}^6} + \frac{c}{\bar{v}^3 \cdot T^2} \cdot \left(1 + \frac{\gamma}{\bar{v}^2}\right) \cdot e^{-\gamma/\bar{v}^2}$$

$R_u = 8{,}314$ kJ/kmole·K , $\bar{v} = 0{,}9156$ m³/kmole

$a = 2{,}54$ $A_0 = 106{,}73$ $b = 0{,}002328$

$B_0 = 0{,}04074$ $c = 7{,}379 \times 10^4$ $C_0 = 8{,}164 \times 10^5$

$\alpha = 1{,}272 \times 10^{-4}$ $\gamma = 0{,}0053$

$p = 2000{,}7$ (kPa)

Σφάλμα: $\frac{2009{,}7 - 2000}{2000} \times 100 = 0{,}035\%$

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5. $Z = \frac{P_1 \cdot v}{R_1 \cdot T}$ $v = \frac{V}{M} = \frac{9{,}27}{100} = 0{,}00327$ (m³/kg)

$P_r = 0{,}602$
$T_r = 1{,}782$
$\Big\} \rightarrow Z = 0{,}88$