Relationships that will be provided with Exam 1. You are responsible for knowing to what circumstance a relationship is applicable.

Constants and units

$R = 8.314\ J\ K^{-1}\ mol^{-1} = 8.314 \times 10^{-2}\ L\ bar\ K^{-1}\ mol^{-1} = 8.206 \times 10^{-2}\ L\ atm\ K^{-1}\ mol^{-1}$

1 L bar = 100 J

1 atm = 1.01325 bar = 760 Torr $1\ cm^3 = 0.001\ L$

$1\ bar = 10^5\ Pa$

$1\ J = 1\ kg\ m^2\ s^{-2}$

$g = 9.81\ m\ s^{-2}$

$N_A = 6.022 \times 10^{23}\ mol^{-1}$

Gases and molecular speeds

$$Z = \frac{P\bar{V}}{RT} = 1 + \frac{B}{\bar{V}} + \frac{C}{\bar{V}^2} + \cdots$$

$$P = \frac{RT}{\bar{V} - b} - \frac{a}{\bar{V}^2}$$

$$f(c) = 4\pi c^2 \left(\frac{m}{2\pi k_B T}\right)^{3/2} e^{-mc^2/2k_B T}$$

$$\frac{dN}{N} = f(c)dc$$

$$\lambda = \frac{RT}{\sqrt{2}d^2 P N_A}$$

$$Z_1 = \sqrt{2}d^2\bar{c}\left(\frac{N}{V}\right)$$

$$c_{mp} = \sqrt{\frac{2RT}{M}} \qquad \bar{c} = \sqrt{\frac{8RT}{\pi M}} \qquad c_{rms} = \sqrt{\frac{3RT}{M}}$$

Thermodynamic relationships

$\Delta U = q + w \qquad dU = dq + dw$

$H = U + PV$

$w = -P_{ex}\Delta V$

$w = -nRT \ln(V_f/V_i)$

$$C = \frac{q}{\Delta T}$$

$\Delta H = \int_{T1}^{T2} C_p\, dT \approx C_p \Delta T$

$S = k_B \ln W$

$\Delta C_p = \Sigma \nu C_p(\text{Products}) - \Sigma \nu C_{p,}(\text{Reactants})$

$\Delta_r H(T_2) = \Delta_r H(T_1) + \Delta C_p(T_2 - T_1)$

Integrals

$$\int \frac{1}{x-a}dx = \ln(x-a) + C$$

$$\int x^n = \frac{1}{n+1}x^{n+1} + C \quad (n \neq -1)$$