DATA SHEET – *For convenience, you may tear off this sheet and use it during the exam period. There is no need to hand in this sheet at the end of the exam. You may keep it or trash it.*

Equations and Constants

Constants

$R = 1.9872 \text{ cal mol}^{-1} \text{ K}^{-1} = 8.3145 \text{ J mol}^{-1} \text{ K}^{-1}$
$= 0.082057 \text{ atm L mol}^{-1} \text{ K}^{-1} = 0.083145 \text{ bar L mol}^{-1} \text{ K}^{-1}$
$= 8.3145 \text{ Pa m}^3 \text{ mol}^{-1} \text{ K}^{-1} = 62.364 \text{ torr L mol}^{-1} \text{ K}^{-1}$

$0°\text{C} = 273.15 \text{ K}$

General equations

$$dU = \left(\frac{\partial U}{\partial T}\right)_V dT + \left(\frac{\partial U}{\partial V}\right)_T dV$$

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

For a (monatomic) ideal gas

$$P = \frac{nRT}{V} \quad \text{and} \quad \left(\frac{\partial U}{\partial V}\right)_T = 0$$

$$\frac{C_P}{n} = \frac{5}{2}R \quad \text{and} \quad \frac{C_P}{n} - \frac{C_V}{n} = R$$

For a van der Waals gas

$$P = \frac{nRT}{V - nb} - \frac{n^2 a}{V^2} \quad \text{and} \quad \left(\frac{\partial U}{\partial V}\right)_T = \frac{n^2 a}{V^2}$$

Gibbs-Helmholtz equation

$$\left(\frac{\partial}{\partial T}\left(\frac{G}{T}\right)\right)_P = -\frac{H}{T^2} \quad \text{or} \quad \left(\frac{\partial}{\partial T}\left(\frac{\Delta G}{T}\right)\right)_P = -\frac{\Delta H}{T^2}$$

Gibbs free energy: $\Delta G^\Theta = -RT \ln K$

Fundamental equation: $dU = TdS - PdV$

The thermodynamics magic square