First Examination
Feb 1, 2008
No Calculators, please put them away.
Useful information and equations:

Law IA: $\Delta U = q + w$

Law IB:

$U = U(T,V)$

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

$H = U + PV$

Heat Capacity

$$C_V = \left(\frac{\partial U}{\partial T}\right)_V$$

$$C_P = \left(\frac{\partial H}{\partial T}\right)_P$$

Work:

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

$w = -P_{ext}dV$

$w = mgh$

$w = IQt$

Kinetic Energy: $\varepsilon = \frac{mv^2}{2}$

Isothermal Reversible work:

$$w = -nRT\ln\left(\frac{V_f}{V_i}\right)$$

$PV = Const$

Adiabatic Reversible work: $w = -PdV$

$P\left(V^{\gamma}\right) = Const$; where $\gamma = \frac{C_{P,m}}{C_{V,m}}$

Thermodynamic Equation of State

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

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

Integral Identity:

$$\Delta Z = \int_{x_i}^{x_f}\left(\frac{\partial Z}{\partial x}\right)_y dx$$

Thermal expansion and compression coefficient

$$\beta = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$$

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

IG EoS (and other IG relations)

$PV_m = RT$

$C_{P,m} = C_{V,m} + R$

$\Delta U = C_V\Delta T$

$\Delta H = C_P\Delta T$

VdW EoS

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

Cyclic rule:

$$\left(\frac{dx}{dy}\right)_z\left(\frac{dz}{dx}\right)_y\left(\frac{dy}{dz}\right)_x = -1$$

Chain Rules:

$$\frac{d(yz)}{dx} = z\frac{d(y)}{dx} + y\frac{d(z)}{dx}$$

$$\frac{dx}{dz} = \frac{dy}{dz}\frac{dx}{dy}$$

Gas Constant:

$R = 8.314 J/mol - K$

$R = 0.082 L - atm/mol - K$

$R \cdot 298.13 = 2.48 kJ/mol$

$1 bar = 10^5 Pa$

$T(K) = T(C) + 273.15$

Show your work throughout, and always show units for computed quantities

Name _____

ID_____