PS 160 – Physics II for Engineers
Exam #3 Review
Chapters 17, 18, 19, 20

HEAT & TEMPERATURE

Celsius: $T_C = \frac{5}{9}(T_K - 32)$ Kelvin: $T_K = T_C + 273.15$

Expansion coefficients: $\Delta L = \alpha L_0 \Delta T$ $\Delta V = \beta V_0 \Delta T$

Heat capacity: $Q = mc\Delta T$ $Q = nC\Delta T$

Fusion/vaporization: $Q = \pm mL$

IDEAL GAS

$pV = nRT = NkT$ $R = 8.314472 \frac{\text{J}}{\text{mol K}}$ $k = 1.3806503 \times 10^{-23} \frac{\text{J}}{\text{K}}$

$\frac{1}{2} m\left(v^2\right)_{ave} = \frac{3}{2} kT = \frac{3}{2}\left(\frac{R}{N_A}\right) T$ $N_A = 6.02214199 \times 10^{23}$

$v_{rms} = \sqrt{\frac{3kT}{m}}$

$C_V = \frac{f}{2} R$ f = 3 (monatomic), 5 (diatomic) $C_P = C_V + R$ $\gamma = \frac{C_P}{C_V}$

U is a function of T only

THERMODYNAMIC PROCESSES

First Law: $\Delta U = Q - W$

$dU = dQ - dW = TdS - pdV$ (infinitesimal)

Second Law: $\Delta S \geq 0$ $\Delta S = \int \frac{dQ}{T}$ (reversible process)

isothermal: $pV = \text{constant}$

adiabatic: $Q = 0$ $pV^\gamma = \text{constant}$ $TV^{\gamma - 1} = \text{constant}$

constant volume: $W = 0$

ENGINES / REFRIGERATORS

thermal efficiency: $e = \frac{W}{Q_H} = \frac{Q_H + Q_C}{Q_H}$

coefficient of performance: $K = \frac{Q_C}{|W|}$

Carnot cycle: $e = 1 - \frac{T_C}{T_H}$ Otto cycle: $e = 1 - \frac{1}{R^{\gamma - 1}}$