

Formula Sheet for Exam 4
PHYS 1110 Section 02

$$Q = mc\Delta T$$

$$Q = mL$$

$$\Delta L = \alpha L_0(T - T_0)$$

$$\Delta V = \beta V_0(T - T_0)$$

$$\beta = 3\alpha$$

$$\Delta U = Q - W$$

Ideal gas:

$$pV = nRT$$

Constant-pressure process:

$$W = p\Delta V$$

Constant-temperature process:

$$W = nRT \ln(V_2/V_1)$$

Constant-volume process:

$$W = 0$$

Entropy:

$$\Delta S = Q_{\text{rev}}/T$$

$$\Delta S \geq 0$$

Heat engine

$$e = \frac{W}{Q_h} \leq 1 - T_c/T_h$$

Refrigerator, air conditioner

$$\text{COP} = \frac{Q_c}{W} \leq \frac{T_c}{T_h - T_c}$$

Heat pump

$$\text{COP} = \frac{Q_h}{W} \leq \frac{T_h}{T_h - T_c}$$

Heats of melting: (kJ/kg)

Aluminum	321
Ethyl alcohol	107
Iso-octane	79.1
Mercury	98.8
Water	334

Specific heat capacities ($\frac{\text{J}}{\text{kg}\cdot\text{K}}$):

Aluminum	897
Ethyl alcohol	2440
Flint glass	840
Iron	449
Iso-octane	2123
Mercury	140
Motor oil	2000
Steel	490
Water (ice)	2090
Water (liquid)	4184

Linear thermal expansion α ($10^{-6} \frac{\text{m}}{\text{m}\cdot^\circ\text{C}}$)

Aluminum	22
Flint glass	9.0
Iron	11.3
Steel	11.6
Water (ice)	50
Wood (across grain)	30
Wood (with grain)	3

Volume thermal expansion β ($10^{-3} \frac{\text{cm}^3}{\text{cm}^3\cdot^\circ\text{C}}$)

Ethyl alcohol	1.09
Iso-octane	0.95
Mercury	0.18
Motor oil	0.70

(Why not water?)