Homework set #1 Thermodynamics of Materials Due: Mar. 17, 2014

1. Explain the following terms.

system, open system, closed system
surroundings
thermodynamic equilibrium
thermodynamic temperature scale
state function
path function
isothermal process
isobaric process
isochoric (isometric) process
diathermic boundary
adiabatic boundary
equation of state for an ideal gas (ideal gas law)
reversible process
irreversible process
heat
heat capacity at constant pressure, heat capacity at constant volume
work
internal energy
enthalpy
Carnot cycle
entropy
spontaneous process
Zeroth Law of Thermodynamics
First Law of Thermodynamics
Second Law of Thermodynamics
Third Law of Thermodynamics

2. Answer the following questions for the following properties of a system.

P, T, V, C_v, C_p, w, q, U, H, S

(a) Classify these into intensive or extensive variables.

(b) Classify these into state or path functions.

3. Explain the relationship between the terms exact differential and state function.

4. Why does the relation $C_p > C_v$ always hold for a gas?
Can $C_p < C_v$ be valid for a liquid?

5. Solve the following six problems in the textbook (5th ed. Gaskell)

2.3, 2.5. 2.7 in Chap. 2

3.2, 3.4, 3.6 in Chap. 3

Homework set #2 Thermodynamics of Materials Due: Apr. 7, 2014

1. Solve the following six problems in the textbook (5th ed. Gaskell).

3.2, 3.4, 3.6 in Chap. 3

(If you have already solved these problems in previous Homework set #1, you don't need to solve them again.)

2. Referring to Chap. 1 (pp. 10-17) of reference book [D. V. Schroeder, *An introduction to thermal physics*, Addison Wesley Longman, 2000],

(a) show that the average translational kinetic energy of an ideal gas is given by $\overline{K_{trans}} = \frac{3}{2}kT$.

(b) Explain the equipartition theorem.

(c) Using the equipartition theorem, show that $C_v = 3R$ for a solid where $R = Nk$.

3. Solve the following three problems in the textbook (5th ed. Gaskell).

4.1, 4.3, 4.4 in Chap. 4

4. Solve the following seven problems in textbook (5th ed. Gaskell).

5.2, 5.4, 5.6, 5.8, 5.10, 5.11, 5.12

Homework set #3 Thermodynamics of Materials Due: Apr. 14(Mon), 2014

1. Show that theoretical calculations for the constant-volume molar heat capacity (c_v) of a crystal by both Einstein and Debye are in agreement with Dulong and Petit's law since $c_v \rightarrow 3R$ with increasing T.

2. Solve the following six problems in textbook (5th ed. Gaskell).

6.1, 6.3, 6.5, 6.8, 6.9, 6.10

Homework set #4 Thermodynamics of Materials Due: May. 7(Wed), 2014

1. Solve the following four problems in textbook (5th ed. Gaskell).
   7.2, 7.4, 7.6, 7.8
2. Solve the following four problems in textbook (5th ed. Gaskell).
   8.1, 8.3, 8.5, 8.

Homework set #5 Thermodynamics of Materials Due: May. 21(Wed), 2014

1. Solve the following four problems in textbook (5th ed. Gaskell).
   9.2, 9.4, 9.6, 9.8, 9.10

Homework set #6 Thermodynamics of Materials Due: June 9(Mon), 2014

1. Solve the following problems in the textbook (5th ed. Gaskell).
   10.1, 10.3, 10.5, 10.7, 11.2, 11.4, 11.6, 11.8

Homework set #7 Thermodynamics of Materials Due: June 12 (Thu), 2014

1. Solve the following problems in textbook (5th ed. Gaskell).
   12.3, 12.7, 12.13, 13.4, 13.6, 13.9