ES 202 Fluid and Thermal Systems — Name:
Answers to Quiz 4 (2/3/03) — Box:

1. Write down the two versions of the Gibbs equation for a <u>general substance.</u>
   a)
   $$Tds = du + Pdv$$
   b)
   $$Tds = dh - vdP$$

2. How do the above two versions of the Gibbs equation simplify to respectively for an <u>ideal gas?</u>
   a)
   $$ds = \frac{c_v\, dT}{T} + \frac{R\, dv}{v}$$
   b)
   $$ds = \frac{c_p\, dT}{T} - \frac{R\, dP}{P}$$

3. For an <u>ideal gas</u> in its general case (*i.e.* variable specific heats), complete followings:
   $$\Delta u = \int c_v\, dT$$
   $$\Delta h = \int c_p\, dT$$
   $$\Delta s = \int c_p \frac{dT}{T} - \int R \frac{dP}{P}$$

4. Determine if the following statements are true or false.
   a) <u>*False*</u> The Gibbs equation is only true for internally reversible processes.

   b) <u>*False*</u> $\Delta h = c_p\, \Delta T$ AND $\Delta u = c_v\, \Delta T$ are only true for constant pressure and constant specific volume processes in an ideal gas respectively.

c) *True* The specific internal energy of an ideal gas depends only on its temperature.

d) *True* The specific enthalpy of an ideal gas depends only on its temperature.

e) *False* The specific entropy of an ideal gas depends only on its temperature.

4. Under what conditions would the Ideal Gas Model be a good approximation to the real behavior of a substance in its gaseous state.

- **lower pressure**
- **high temperature**

5. List the conditions of validity (assumptions) for the following commonly used relations:

a) $Pv^k = \text{constant}$

- **ideal gas**
- **isentropic (not isothermal)**
- **constant specific heats**

b) $s_2 - s_1 = s_2^0 - s_1^0 - R\log\left(\frac{P_2}{P_1}\right)$

- **ideal gas**