CM3230
Chemical Engineering Thermodynamics
Fall 2014
Quiz 1a

Name: _____ _____

(Circle only one answer for each item. Each item is worth 20 points. Answer 5 items correctly for full 100 points. If all 6 items are correct, then a bonus of 20 points will be awarded.)

1. An ideal gas in a piston-cylinder undergoes a cycle starting with a irreversible expansion with a sudden drop in external pressure from P_1 to P_2 accompanied with an molar volume increase from v_1 to v_2. This is followed by an irreversible compression from a sudden increase in external pressure from P_2 to P_1, accompanied with an molar volume decrease from v_2 to v_1. The net heat transferred into the gas system for each cycle is given by
   a. $q_{in} = P_2 v_2 - P_1 v_1$
   b. $q_{in} = (P_1 - P_2)(v_2 - v_1)$
   c. $q_{in} = 0$
   d. None of the above

2. At $T = 200°C$, saturated steam has molar volume of liquid and vapor given by $\hat{v}_l = 0.0012\ m^3/kg$ and $\hat{v}_v = 0.1274\ m^3/kg$. If wet steam at $200°C$ is contained in a closed $0.1\ m^3$ vessel with a steam quality given by $x = 0.8$, the mass of wet steam is
   a. $m = 0.98\ kg$
   b. $m = 1.55\ kg$
   c. $m = 3.78\ kg$
   d. None of the above

3. An ideal gas undergoes a reversible adiabatic expansion, doubling its original volume. Assuming constant heat capacities and $k = c_p/c_v = 5/3$, then pressure will decrease by a fraction closest to
   a. $(P_i - P_f)/P_i = 0.125$
   b. $(P_i - P_f)/P_i = 0.315$
   c. $(P_i - P_f)/P_i = 0.685$
   d. None of the above

4. An ideal gas at pressure P_1 undergoes a reversible polytropic expansion from v_1 to $v_2 = 2v_1$ with a path $Pv^3 = \text{constant}$. The reversible work done by the gas is
   a. $w_{by} = 8P_1v_1^3$
   b. $w_{by} = \left(\frac{3}{8}\right) P_1v_1$
   c. $w_{by} = P_1v_1$
   d. None of the above

5. An ideal gas has a heat capacity of $c_v = 2.5R$. One mole of the gas in a closed piston-cylinder system underwent an adiabatic process where work of the amount $W_{by} = 2\ kJ$ was done by the gas. The change in temperature is then given by
   a. $T_f - T_i = -96\ K$
   b. $T_f - T_i = 98\ K$
   c. $T_f - T_i = 0$
   d. None of the above

6. A rigid insulated vessel contains two compartments separated by an impermeable membrane. On one compartment is an ideal gas at P_i and $T = 100°C$ occupying $1/3$ of space of the vessel. The other compartment is a vacuum. After the membrane ruptures, the whole vessel settles to $P_f = 1.5\ bar$. The initial pressure is
   a. $P_i = 3\ bar$
   b. $P_i = 4.5\ bar$
   c. $P_i = 0.5\ bar$
   d. None of the above