CM3230
Chemical Engineering Thermodynamics
Fall 2014
Quiz 2a

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. 10 moles of an incompressible liquid is cooled from $T_i = 350K$ to $T_f = 290K$. The temperature of the surroundings is constant at $T_{surr} = 280\ K$. The molar heat capacity of the liquid is $c_p = 2.8\ R$. The change is entropy of the surroundings is then given by
   a) $\Delta S_{surr} = -4R$
   b) $\Delta S_{surr} = 4R$
   c) $\Delta S_{surr} = 6R$
   d) $\Delta S_{surr} = 25\ kJ/K$
   e) None of the above

2. A Carnot cycle is operating with a hot reservoir at $T_H = 500°C$ and a cold reservoir at $T_C = 20°C$. The Carnot efficiency is thus given by
   a) $\eta = 0.04$
   b) $\eta = 0.32$
   c) $\eta = 0.48$
   d) $\eta = 0.62$
   e) $\eta = 0.96$

3. 20 moles of an ideal gas first expanded from $T_1 = 20°C$, $P_1 = 1\ bar$ to $T_2 = 15°C$, $P_2 = 0.5\ bar$. Then it got compressed to $T_3 = 20°C$, $P_3 = 1.5\ bar$. The change in entropy of the gas from condition 1 to 3 is given by
   a) $\Delta S = 20\ R \ln(3/2)$
   b) $\Delta S = 20\ R \ln(2/3)$
   c) $\Delta S = 20\ R \ln(2)$
   d) $\Delta S = 20\ (R \ln(288/293) - R \ln(3/2))$
   e) None of the above

4. An isolated rigid vessel contains two compartments of equal volumes separated by a thin membrane. One compartment contains 10 moles of an ideal gas at $P = 1\ bar$, while the other compartment is at vacuum. The membrane ruptures and allows the gas to fill the whole vessel. The change in entropy of the universe is then given by
   a) $\Delta S_{univ} = 0$
   b) $\Delta S_{univ} = 10\ R \ln(2)$
   c) $\Delta S_{univ} = 10\ R \ln(3/2)$
   d) $\Delta S_{univ} = 10\ R(\ 1 - \ln(2)\ )$
   e) None of the above

5. A countercurrent heat exchanger has liquid A with a constant molar heat capacity $c_{p,A}$ flowing in at temperature $T_{in,A}$ and flowing out at temperature $T_{out,A} = 1.2\ T_{in,A}$ at a molar flow rate of $\dot{n}_A$. The rate of change in entropy of liquid A as it passes through the exchanger is given by
   a) $\Delta \dot{S} = 0.2\ \dot{n}_A c_{p,A}$
   b) $\Delta \dot{S} = \dot{n}_A c_{p,A}$
   c) $\Delta \dot{S} = -(\ln(1.2))\ \dot{n}_A c_{p,A}$
   d) $\Delta \dot{S} = -0.2\ \dot{n}_A c_{p,A}\ T_{in,A}$
   e) None of the above

6. 10 moles of an ideal gas undergoes an isenthalpic expansion through a throttle from $P_1 = 2\ bar$ to $P_2 = 0.1\ bar$. The temperature of the surrounding is $T = 300\ K$. Then the change in entropy of the universe is given by
   a) $\Delta S_{univ} = 10\ R \ln(0.05)$
   b) $\Delta S_{univ} = 10\ R \ln(1.9)\ /300$
   c) $\Delta S_{univ} = -10\ R \ln(0.9)$
   d) $\Delta S_{univ} = 10\ R \ln(20)$
   e) None of the above