CM3230, Fall 2015
Quiz 4a
Name ___________________________________

Answer 5 items for full 100 points. The 6^{th} correct answer will be considered a 20 point bonus.

1. A real gas with $c_{P,\text{Ideal}} = 2.5R$ is expanded from reduced inlet conditions of $T_{r1} = 0.3$ and $P_{r1} = 4$ to the outlet reduced conditions of $T_{r2} = 0.6$ and $P_{r2} = 0.26$. Based on the Lee-Kesler charts and assuming $\omega = 0$, the change in molar entropy will be closest to
   a. $\Delta s = -3.3R$
   b. $\Delta s = -0.5R$
   c. $\Delta s = +4.2R$
   d. $\Delta s = +10.5R$
   e. None of the above

2. Using the Lee-Kesler charts, the heat of vaporization for a substance at a reduced temperature $T_r = 0.8$ with a critical temperature $T_c = 500K$ and $\omega = 0.2$ will have a heat of vaporization closest to
   a. $\Delta h_{vap} = -2.5 \frac{kJ}{mole}$
   b. $\Delta h_{vap} = +11.0 \frac{kJ}{mole}$
   c. $\Delta h_{vap} = +20.2 \frac{kJ}{mole}$
   d. $\Delta h_{vap} = +52.3 \frac{kJ}{mole}$
   e. None of the above

3. A rigid insulated cylinder is separated into two equal sections by a membrane. One section has a molar volume v of a real gas having $c_v^{real} = (3/2)R$ and behaves according to the Van der Waals equation of state, i.e.

$$P = \frac{RT}{v-b} - \frac{a}{v^2}$$

   The other section is evacuated. The final temperature after the membrane breaks will then be given by
   a. $T_f = T_i$
   b. $T_f = T_i - a/(3Rv)$
   c. $T_f = T_i - a/(12Rv^2)$
   d. $T_f = T_i - 14a/(8Rv^3)$
   e. None of the above

4. A vapor-liquid mixture having 50% vapor at a reduced pressure $P_r = 0.6$ and $\omega = 0$ will have enthalpy departure value closest to
   a. $\Delta h^{dep} = +2.4RTc$
   b. $\Delta h^{dep} = +2RT_c$
   c. $\Delta h^{dep} = -2RT_c$
   d. $\Delta h^{dep} = -2.5RT_c$
   e. None of the above

5. A real gas undergoes an isothermal expansion from $P_{in} = 40\ bar$s to $P_{out} = 4\ bars$ and delivers work per kg of gas at the amount of $w_{by,s} = 1\ kJ/kg$. Suppose the enthalpy departure values at the inlet and outlet are given by $\Delta h_{in}^{dep} = -2\ kJ/kg$ and $\Delta h_{out}^{dep} = -0.5\ kJ/kg$, respectively, then the heat absorbed by the gas from inlet to outlet per kg of gas is given by
   a. $q_{in} = -2.5\ kJ/kg$
   b. $q_{in} = -1.5\ kJ/kg$
   c. $q_{in} = +1.5\ kJ/kg$
   d. $q_{in} = +2.5\ kJ/kg$
   e. None of the above

6. A real gas at $T = 300K$ with heat capacity $c_p^{real} = 1.2R$ was found to have
$$(\partial h/\partial P)_T = 0.15 \frac{J}{bar \cdot mole}$$
   The Joule-Thomson coefficient at this temperature is closest to (Hint: use cyclic relationship and definitions $\mu_{JT} = (\partial T/\partial P)_h$ and $c_p = (\partial h/\partial T)_P$)
   a. $\mu_{JT} = -0.101\ K/bar$
   b. $\mu_{JT} = -0.015\ K/bar$
   c. $\mu_{JT} = +0.015\ K/bar$
   d. $\mu_{JT} = +0.025\ K/bar$
   e. None of the above