

CH353 – Physical Chemistry I
Spring 2015, Unique 51170

Extra Credit Quiz

****DUE BY 9 am on 18 MAY 2015 – NO EXCEPTIONS****

Directions: For each question, circle the correct answer. Many questions have more than one correct answer. Each question is worth 2 points and there will be no partial credit.

1. Which is denser?
 - a. 1 L of dry air at 1 atm and 25°C
 - b. 1 L of humid air at 1 atm at 25°C
 - c. Not enough information to determine

2. A container with rigid walls is filled with 1 atm of Ar at room temperature, then heated to 100°C. What is the sign of work?
 - a. $w > 0$
 - b. $w < 0$
 - c. $w = 0$
 - d. Not enough information to determine

3. Acetone in an open beaker on the laboratory bench evaporates. What is the sign of work?
 - a. $w > 0$
 - b. $w < 0$
 - c. $w = 0$
 - d. Not enough information to determine

4. 10 L of air at 1 atm is compressed reversibly to a final volume of 1 L. What is the sign of work?
 - a. $w > 0$
 - b. $w < 0$
 - c. $w = 0$
 - d. Not enough information to determine

5. For a monatomic ideal gas, which is larger?
 - a. C_v
 - b. C_p
 - c. It depends on the temperature of the system.
 - d. There is no way to determine this without an experimental measurement.

6. The following molecules are correctly ranked in order of increasing molar entropy: $\text{CH}_3\text{Cl}(\text{g}) < \text{CH}_2\text{Cl}_2(\text{g}) < \text{CHCl}_3(\text{g})$
 - a. True
 - b. False

Questions 7-9 refer to the following system: A container of honey crystallizes after sitting the pantry for a year.

7. What is the sign of ΔS_{sys} ?
- $\Delta S_{sys} > 0$
 - $\Delta S_{sys} < 0$
 - $\Delta S_{sys} = 0$
 - Not enough information to determine.
8. What is the sign of ΔS_{surr} ?
- $\Delta S_{surr} > 0$
 - $\Delta S_{surr} < 0$
 - $\Delta S_{surr} = 0$
 - Not enough information to determine.
9. What is the sign of ΔS_{tot} ?
- $\Delta S_{tot} > 0$
 - $\Delta S_{tot} < 0$
 - $\Delta S_{tot} = 0$
 - Not enough information to determine.

Questions 10-12 refer to the following system: 1 mol of oxygen gas initially at a pressure of 10 atm, expands adiabatically against a constant external pressure of 1 atm until mechanical equilibrium is reached.

10. What is the sign of ΔS_{sys} ?
- $\Delta S_{sys} > 0$
 - $\Delta S_{sys} < 0$
 - $\Delta S_{sys} = 0$
 - Not enough information to determine.
11. What is the sign of ΔS_{surr} ?
- $\Delta S_{surr} > 0$
 - $\Delta S_{surr} < 0$
 - $\Delta S_{surr} = 0$
 - Not enough information to determine.
12. What is the sign of ΔS_{tot} ?
- $\Delta S_{tot} > 0$
 - $\Delta S_{tot} < 0$
 - $\Delta S_{tot} = 0$
 - Not enough information to determine.

13. Can diamond be spontaneously converted to graphite at 25°C and 1 atm?
- Yes
 - No
 - Not enough information to determine.
14. For any substance, the change in enthalpy of sublimation is greater than the change in enthalpy of evaporation always.
- True
 - True
15. In a binary mixture, component 1 is more volatile than component 2. Which of the following statements are true?
- The vapor pressure of 1 is greater than the vapor pressure of 2.
 - The vapor pressure of 1 is less than the vapor pressure of 2.
 - It is not possible to determine the relative vapor pressures from this information.
 - The boiling temperature of 1 is greater than the boiling temperature of 2.
 - The boiling temperature of 1 is less than the boiling temperature of 2.
 - It is not possible to determine the relative boiling temperatures from this information.
16. Which of the following mixtures are likely to make an ideal solution?
- Hexane (C₆H₁₄) and heptane (C₇H₁₆).
 - Hexane (C₆H₁₄) and cyclohexane (C₆H₁₂).
 - Acetone ((CH₃)₂CO) and water (H₂O).
 - Acetone ((CH₃)₂CO) and formaldehyde (CH₂O).
17. A nonideal mixture that is dominated by higher repulsive intermolecular forces than in the pure liquids will have $k_H > P^*$.
- True
 - False
18. The equilibrium constant of a certain reaction is found to be 4.2×10^{-3} . Which of the following statements is true?
- At equilibrium, there are more reactants than products.
 - At equilibrium, there are more products than reactants.
 - At equilibrium, the amount of products is equal to the amount of reactants.
 - There is no way to determine the relative amount of reactants and products from this information.
19. In the following reaction, the total pressure of the system is doubled. Which of the following statements is true?
- $$\text{SO}_3(\text{g}) \rightarrow \text{SO}_2(\text{g}) + 1/2 \text{O}_2(\text{g})$$
- The reaction equilibrium does not change.
 - The reaction equilibrium moves to generate more products.
 - The reaction equilibrium moves to generate more reactants.
 - There is not way to determine if and how the reaction equilibrium changes.

20. For a certain reaction, $\Delta H_{rxn}^0 > 0$. Which of the following statements are true?
- Increasing temperature will increase K_p .
 - Increasing temperature will decrease K_p .
 - Increasing temperature will increase the amount of products formed, but has no effect on K_p .
 - Increasing temperature will decrease the amount of products formed, but has no effect on K_p .
 - All of the above.
 - None of the above.
21. $N_2(g)$ at 1 atm and $25^\circ C$ has a higher root mean square speed than $N_2(g)$ at 10 atm and $25^\circ C$.
- True
 - False
22. A molecule with a high collision frequency will also have a large mean free path.
- True
 - False
23. For the reaction $NO_2(g) + CO(g) \rightarrow CO_2(g) + NO(g)$, the experimentally determined rate law is $v(t) = k[NO_2]^2$. Which of the following statements are true?
- The reaction is first order in $NO_2(g)$ and first order in $CO(g)$.
 - The reaction is second order in $NO_2(g)$.
 - $v(t) > 0$.
 - The units of k are $L \text{ mol}^{-1} \text{ s}^{-1}$.
 - The reaction is second order overall.
 - This reaction occurs in one elementary step.
 - $CO(g)$ is a catalyst in this reaction.
24. The reaction $A + B \rightarrow C + D$ is found to proceed through the following mechanism:
- $A + A \rightarrow I_1$
 - $I_1 + B \rightarrow I_2$
 - $I_2 \rightarrow C + D$
- where the first step is found to be rate determining. Which of the following statements are true?
- $d[I_1]/dt = 0$.
 - k_1 is the largest rate constant in this mechanism.
 - I_1 is stable and builds up concentration over the time of reaction.
25. Which of the following statements are true about the molecule C_6H_{14} ?
- It is linear.
 - It has 20 total degrees of freedom.
 - It has 54 internal degrees of freedom.