AP CHEMISTRY CHAPTER 17 PRACTICE TEST

1. A reaction that proceeds without external energy input is said to be:
2. non-spontaneous
3. at equilibrium
4. spontaneous
5. activated
6. none of the above
7. Which of these processes involves an increase in entropy of the system?
8. Ag+(aq) + Cl-(aq) → AgCl(s)
9. Growing flowers
10. Making ice
11. Burning your chemistry notes
12. None of the above
13. If ΔGo for a certain reaction has a negative value at 298 K, which of the following must be true?
14. The reaction is exothermic
15. The reaction occurs spontaneously at 298 K
16. The rate of the reaction is fast at 298 K
17. I only
18. II only
19. I and II only
20. II and III only
21. I, II, and III
22. N2(g) + 3H2(g) → 2NH3(g)

The reaction indicated above is thermodynamically spontaneous at 298 K, but becomes nonspontaneous at higher temperatures. Which of the following is true at 298 K?

1. ΔG, ΔH, and ΔS are all positive
2. ΔG, ΔH, and ΔS are all negative
3. ΔG and ΔH are negative but ΔS is positive
4. ΔG and ΔS are negative but ΔH is positive
5. ΔG and ΔH are positive but ΔS is negative
6. A reaction that has a positive value of ΔS:
7. will not be spontaneous
8. will be spontaneous
9. absorbs heat from the surroundings
10. has a negative value of ΔG
11. will proceed as long as ΔH is not too positive
12. A reaction with a negative value of ΔG:
13. is spontaneous
14. is fast
15. is slow
16. is not spontaneous
17. none of these
18. A reaction that has a positive value of ΔS and a negative value of ΔH will be spontaneous under what circumstances?
19. under no circumstances
20. at low temperatures
21. at high temperatures
22. at all temperatures
23. none of the above
24. Use the information below to answer the following question. What is the value of ΔS for the following reaction?

2C2H2(g) + 5O2(g) → 4CO2(g) + 2H2O(l)

|  |  |
| --- | --- |
| SUBSTANCE | S (J/K.mol) |
| C2H2(g) | 200.8 |
| O2(g) | 205.0 |
|  CO2(g) | 213.6 |
| H2O(l) | 69.91 |

1. +432.4 J/K
2. -122.3 J/K
3. -432.4 J/K
4. +689.3 J/K
5. +122.3 J/K
6. The ΔGof of \_\_\_\_\_\_ is zero.
7. H2O(l)
8. O(g)
9. H2(g)
10. I only
11. II only
12. III only
13. II and III
14. I, II, and III
15. For the process CHCl3(s) → CHCl3(l), ΔHo = 9.2 kJ/mol and ΔSo = 43.9 J/K.mol. What is the melting point of chloroform?
16. -63oC
17. 210oC
18. 5oC
19. 63oC
20. -5oC
21. Consider the hypothetical reaction which proceeds at 310.K Standard free energies in kJ/mol are given in parentheses.

A → B + H2O(l) ΔGo = ?

 (-32.2) (207.8) (-237.0)

What is the value of the equilibrium constant for the reaction at 310.K?

1. 0.31
2. 1.9
3. 1.0
4. 2.2 x 1010
5. 4.5 x 10-11
6. In which reaction is ΔSo expected to be positive?
7. I2(g) → I2(s)
8. H2O(l) → H2O(s)
9. CH3OH(g) + 3/2O2(g) → CO2(g) + 2H2O(l)
10. 2O2(g) + 2SO(g) → 2SO3(g)
11. none of the above
12. For a particular chemical reaction, ΔH = +5.5 kJ and ΔS = +25 J/K

Under what temperature conditions is the reaction spontaneous?

1. When T< -220 K
2. When T< 220 K
3. The reaction is spontaneous at all temperatures
4. The reactions is not spontaneous at any temperature
5. When T > 220 K
6. Consider the reaction

2SO2(g) + O2(g) → 2SO3(g)

For this process ΔHo = -200. kJ and ΔSo = -187 J/K. Calculate the temperature where K = 1.

1. 970. K
2. 2070 K
3. 200. K
4. 1070 K
5. none of these

PROBLEMS

1. In many organisms, glucose is oxidized to carbon dioxide and water, as represented by the following equation.

C6H12O6(s) + 6O2(g) → 6CO2(g) + 6H2O(l)

A 2.50 g sample of glucose and an excess of oxygen gas were placed in a calorimeter. After the reaction was initiated and proceeded to completion, the total heat released by the reaction was calculated to be 39.0 kJ.

1. Calculate the value of ΔHo, in kJ/mol, for the combustion glucose. (don’t make this difficult, use above information and get units in the right place.)
2. When oxygen is not available, glucose can be oxidized by fermentation. In that process, ethanol and carbon dioxide are produced, as represented by the following equation.

C6H12O6(s) → 2C2H5OH(l) + 2CO2(g) ΔHo = -68.0 kJ/mol at 298 K

The value of the equilibrium constant, Kp, for the reaction at 298 K is 8.9 x 1039

1. Calculate the value of the standard free-energy change, ΔGo, for the reaction at 298 K. Include units with your answer.
2. Calculate the value of the standard entropy change, ΔSo, in J/K.mol, for the reaction at 298 K.
3. Indicate whether the equilibrium constant for the fermentation reaction increases, decreases, or remains the same if the temperature is increased. Justify your answer.
4. Using the equations from parts a and b, and your answer from part a, calculate the value of ΔHo for the following reaction.

C2H5OH(l) + 3O2(g) → 2CO2(g) + 3H2O(l)

1. Answer the following questions about the following reaction.

N2(g) + 3H2(g) → 2NH3(g) ΔGo = -34 kJ/mol

1. Calculate the standard free energy change, ΔGo, that occurs when 12.0 g of H2(g) reacts with excess N2(g) at 298 K according the above reaction.
2. The value of the standard entropy change, ΔSo, for the reaction is -199 J/mol.K. Explain why the value is negative
3. Explain what happens to ΔGo as the temperature increases. ΔHo is negative as is ΔSo  from above.
4. Theoretically, the best yields of ammonia should be achieved at low temperatures and high pressures, explain. (Don’t forget Le Chatelier).

ANSWERS

1. C
2. D
3. B
4. A
5. E
6. A
7. D
8. C
9. C
10. A
11. A
12. E
13. E
14. D

PROBLEMS

1

1. -2810 kJ/mol
2. (i) -228 kJ

(ii) 537 J/mol K

(iii)∆H is negative and therefore the reaction is exothermic. As the temperature increases, the rxn shifts left so K decreases.

1. -1371 kJ/mol

2

1. -68 kJ
2. Going from 4 moles of gas to 2 moles of gas. Therefore there are more possible arrangements for 4 molecules. Change in entropy will be negative
3. As temperature increases the T∆S factor gets more positive and eventually ∆G will become positive.

Low temperature: ∆H will drive the reaction right which increases the [NH3]

High pressure: This will drive the reaction to the side that takes up less volume which is the product side. The concentration of [NH3] will increase.