

- The K_{sp} of AgCl is 1.8×10^{-10} . In which of the following aqueous solutions would you expect AgCl to have the lowest solubility?
 - pure water
 - 0.020 M BaCl_2
 - 0.015 M NaCl
 - 0.020 M AgNO_3
 - 0.030 M KCl
- What is the molar solubility of calcium phosphate in pure water at 25°C ? (K_{sp} for $\text{Ca}_3(\text{PO}_4)_2$ is 2.1×10^{-33} .)
 - $4.6 \times 10^{-17} \text{ M}$
 - $1.1 \times 10^{-7} \text{ M}$
 - $1.9 \times 10^{-17} \text{ M}$
 - $6.3 \times 10^{-10} \text{ M}$
 - $1.6 \times 10^{-6} \text{ M}$
- What is the molar solubility of PbI_2 ($K_{sp} = 8.5 \times 10^{-9}$) in a solution containing 0.25 M NaI ?
 - $1.4 \times 10^{-7} \text{ M}$
 - $3.4 \times 10^{-8} \text{ M}$
 - $1.7 \times 10^{-8} \text{ M}$
 - $1.3 \times 10^{-3} \text{ M}$
 - $3.2 \times 10^{-4} \text{ M}$
- What is the pH at the equivalence point when 50.0 mL of 0.100 M acetic acid is titrated with 0.250 M NaOH ? (K_a for CH_3COOH is 1.8×10^{-5} .)
 - 7.95
 - 7.00
 - 11.05
 - 8.80
 - 11.13
- A buffer is made by adding 150.0 mL of 0.175 M benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$, $K_a = 6.5 \times 10^{-5}$) to 125.0 mL of 0.100 M sodium benzoate ($\text{NaC}_6\text{H}_5\text{COO}$). What is the pH of this buffer?
 - 6.73
 - 4.19
 - 3.86
 - 3.94
 - 4.51
- 75.0 mL of a buffer which is 0.30 M in lactic acid ($\text{HC}_3\text{H}_5\text{O}_3$, $K_a = 1.4 \times 10^{-4}$) and 0.30 M in sodium lactate ($\text{NaC}_3\text{H}_5\text{O}_3$) has 10.0 mL of 0.25 M HNO_3 added to it. What is the pH after the HNO_3 has been added?
 - 3.95
 - 3.85
 - 4.04
 - 3.66
 - 3.76
- Suppose that a small amount of HCl is added to a buffer solution containing $\text{HF}(\text{aq})$ and $\text{NaF}(\text{aq})$. What change will occur to the buffer solution?
 - The concentration of hydronium ion will decrease.
 - The concentration of fluoride ion will increase, and the concentration of hydrogen fluoride will increase.
 - The concentration of fluoride ion will increase, and the concentration of hydrogen fluoride will decrease.
 - The concentration of fluoride ion will decrease and the concentration of hydrogen fluoride will increase.
 - The concentration of fluoride ion will decrease and the concentration of hydrogen fluoride will decrease.
- Consider the titration of 125 mL of $0.20 \text{ M CH}_3\text{COOH}$ with 0.15 M NaOH . What is the pH after adding 80 mL of NaOH ? ($K_a = 1.8 \times 10^{-5}$ for CH_3COOH .)
 - 4.71
 - 4.62
 - 4.43
 - 9.38
 - 9.29
- If equal volumes of $4.0 \times 10^{-3} \text{ M Mg}(\text{NO}_3)_2$ and $2.0 \times 10^{-4} \text{ M NaF}$ are mixed, will a precipitate form? (K_{sp} for MgF_2 is 7.4×10^{-11} .)
 - Yes, a precipitate will form.
 - No, a precipitate will not form.
- What is the K_{sp} expression for Ag_2CO_3 ?
 - $K_{sp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}]$
 - $K_{sp} = (2[\text{Ag}^+])^2(3[\text{CO}_3^{2-}])^3$
 - $K_{sp} = \frac{[\text{Ag}^+]^2 [\text{CO}_3^{2-}]}{[\text{Ag}_2\text{CO}_3]}$
 - $K_{sp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}]$
 - $K_{sp} = (2[\text{Ag}^+])^2[\text{CO}_3^{2-}]$
- Determine the normal boiling point (in $^\circ\text{C}$) of TiCl_4 , given that its enthalpy of vaporization (ΔH_{vap}°) is $+41.0 \text{ kJ/mol}$, and its entropy of vaporization (ΔS_{vap}°) is $133 \text{ J/mol}\cdot\text{K}$.
 - $35.3 \text{ }^\circ\text{C}$
 - $79.2 \text{ }^\circ\text{C}$
 - $127 \text{ }^\circ\text{C}$
 - $189 \text{ }^\circ\text{C}$
 - $217 \text{ }^\circ\text{C}$
- In which state would one mole of $\text{Ne}(\text{g})$ have the highest entropy?
 - at 27°C in a volume of 25 L
 - at 137°C in a volume of 25 L
 - at 27°C in a volume of 35 L
 - at 137°C in a volume of 35 L
 - Ne has the same entropy in all four of these states.

13. Which of the following statements must be true for the entropy of a pure solid to be zero?

- I. The temperature must be 0 K.
- II. The solid must be crystalline, not amorphous.
- III. The solid must be perfectly ordered.
- IV. The solid must be an element.

- a) I
- b) I and II
- c) I, II, and III
- d) I, III, and IV
- e) I, II, III, and IV

14. Consider the following thermochemical equation:



When is this reaction spontaneous?

- a) This reaction is spontaneous at all temperatures.
- b) This reaction is spontaneous at low temperatures.
- c) This reaction is spontaneous at high temperatures.
- d) This reaction is not spontaneous at any temperature.

15. Use the thermodynamic data below to determine the standard free energy change, ΔG° , for the following reaction at 25°C.



The standard molar entropies of these substances are as follows:

Al(s)	$S^\circ = 28.3 \text{ J/mol}\cdot\text{K}$
O ₂ (g)	$S^\circ = 205.0 \text{ J/mol}\cdot\text{K}$
Al ₂ O ₃ (s)	$S^\circ = 50.9 \text{ J/mol}\cdot\text{K}$

- a) -3378 kJ
- b) -183 kJ
- c) -3539 kJ
- d) -3165 kJ
- e) 183 kJ

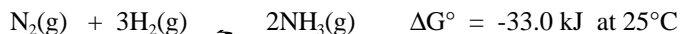
16. Which of the following is the best statement of the second law of thermodynamics?

- a) In any spontaneous process, the entropy of the universe always increases.
- b) In any spontaneous process, the enthalpy of the system always decreases.
- c) In any spontaneous process, the entropy of the system always increases.
- d) In any process, spontaneous or nonspontaneous, the total energy of a system and its surroundings is constant.
- e) In any process, spontaneous or nonspontaneous, the total entropy of a system and its surroundings is constant.

17. What is the equilibrium constant for a reaction that has a standard free energy change $\Delta G^\circ = -5.25 \text{ kJ}$ at 25°C?

- a) 8.32
- b) 1.00
- c) 28.9
- d) 432
- e) 2.77×10^{-4}

18. Consider the following reaction:



What is the value of ΔG at 25°C given the following partial pressures:

10.0 atm N ₂
10.0 atm H ₂
0.100 atm NH ₃

- a) -34.3 kJ
- b) 1.23 kJ
- c) -2900 kJ
- d) -51.7 kJ
- e) -67.2 kJ

19. Which of the following will give a buffer solution when equal volumes of the two solutions are mixed?

- a) 0.10 M HF and 0.10 M NaF
- b) 0.05 M HBr and 0.10 M NaF
- c) 0.20 M HF and 0.10 M NaOH
- d) 0.10 M HCl and 0.20 M NaF
- e) all of the above

20. The melting point of naphthalene is 128°C. What are the signs of ΔH , ΔS , and ΔG for the melting of naphthalene at 25°C?

	ΔH	ΔS	ΔG
a)	+	+	+
b)	+	+	-
c)	-	-	+
d)	-	-	-
e)	+	-	+

Answers:

- | | | | |
|------|-------|-------|-------|
| 1. B | 6. E | 11. A | 16. A |
| 2. B | 7. D | 12. D | 17. A |
| 3. A | 8. A | 13. C | 18. E |
| 4. D | 9. B | 14. B | 19. E |
| 5. C | 10. D | 15. D | 20. A |