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9. Which statement best describes the unique property of a supersaturated solution?
- A. A supersaturated solution must have more solute than solvent.
  - B. A supersaturated solution can dissolve more solute.
  - C. A supersaturated solution has more solute dissolved than predicted by the solubility.
  - D. A supersaturated solution has a precipitated solute in equilibrium with the dissolved solute.

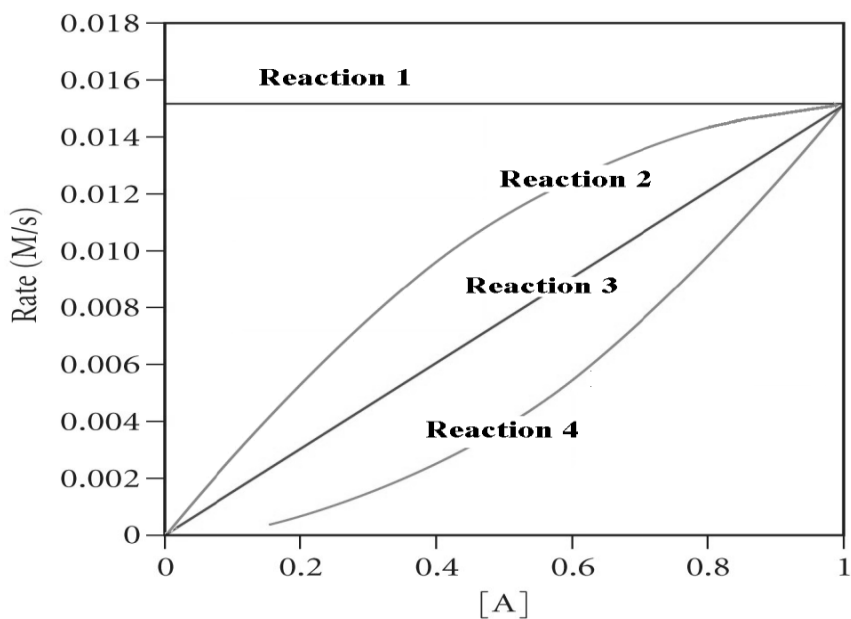
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10. Oxygen is **most** soluble in water at
- A. high temperature and high partial pressure of oxygen.
  - B. low temperature and high partial pressure of oxygen.
  - C. high temperature and low partial pressure of oxygen.
  - D. low temperature and low partial pressure of oxygen.

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11. A 12 *m* HNO<sub>3</sub> aqueous solution contains
- A. 12 g of HNO<sub>3</sub> in 1.00 L of solution.
  - B. 12 g of HNO<sub>3</sub> in 100 mL of water.
  - C. 12 mol of HNO<sub>3</sub> in 1.00 kg of solution.
  - D. 12 mol of HNO<sub>3</sub> in 1.00 kg of water.

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12. What is the freezing point of an aqueous 2.23 *m* ethylene glycol solution? The freezing point constant,  $K_f$ , of water is 1.86 °C/*m*.
- |            |             |
|------------|-------------|
| A. 1.14 °C | C. -4.15 °C |
| B. 5.48 °C | D. -2.23 °C |
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16. The decomposition of  $\text{N}_2\text{O}(g)$  on a Pt surface follows zero-order kinetics.  
 $2 \text{N}_2\text{O}(g) \rightarrow 2 \text{N}_2(g) + \text{O}_2(g)$   
Which curve accurately graphs the relationship between rate and concentration for this reaction?



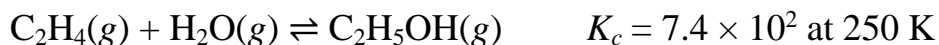
- A. Reaction 1  
B. Reaction 2  
C. Reaction 3  
D. Reaction 4
17. When the Kelvin temperature of a reaction is reduced by half, the value of the rate constant,  $k$
- A. doubles.  
B. increases, but doesn't necessarily double.  
C. decreases by half.  
D. decreases, but not necessarily by half.



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21. Which way will the reaction proceed, given the following initial concentrations?

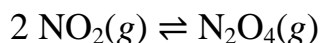
$$[\text{C}_2\text{H}_4] = 0.010 \text{ M}, [\text{H}_2\text{O}] = 0.200 \text{ M}, [\text{C}_2\text{H}_5\text{OH}] = 0.200 \text{ M}$$



- A. to the left because  $Q > K$       C. to the right because  $Q > K$   
B. to the left because  $Q < K$       D. to the right because  $Q < K$

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22. For the following reaction at 298 K,  $K_p = 6.70$ .

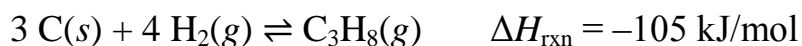


At equilibrium, the partial pressure of  $\text{NO}_2$  is 0.12 atm. Determine the partial pressure of  $\text{N}_2\text{O}_4$  at equilibrium.

- A. 15 atm      C. 1.2 atm  
B. 0.096 atm      D. 0.16 atm

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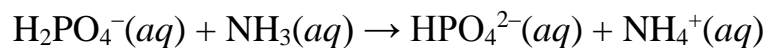
23. Given the following reaction, initially at equilibrium, which change will cause the **greatest** shift in the equilibrium to favor **product** formation?



- A. double the mass of C      C. remove  $\text{H}_2$   
B. decrease the pressure of the container      D. lower the temperature
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24. In the following reaction,  $\text{NH}_3$  is behaving as a(n) \_\_\_\_\_.



- A. Brønsted-Lowry acid                      C. Arrhenius acid  
B. Brønsted-Lowry base                     D. Arrhenius base

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25. Which one of the following acids has the **lowest** percent ionization at 0.100 M?

- A.  $\text{HCN}$ ,  $K_a = 4.9 \times 10^{-10}$                       C.  $\text{HC}_9\text{H}_7\text{O}_4$ ,  $K_a = 3.3 \times 10^{-4}$   
B.  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $K_a = 1.8 \times 10^{-5}$                      D.  $\text{HCl}$ ,  $K_a \gg 1$

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26. Which 0.100 M solution will have the **highest** pH?

- A. ketamine,  $\text{C}_{13}\text{H}_{16}\text{ClNO}$ ,  $K_b = 3.0 \times 10^{-7}$   
B. ammonia,  $\text{NH}_3$ ,  $K_b = 1.76 \times 10^{-5}$   
C. piperidine,  $\text{C}_5\text{H}_{10}\text{NH}$ ,  $K_b = 1.33 \times 10^{-3}$   
D. pyridine,  $\text{C}_5\text{H}_5\text{N}$ ,  $K_b = 1.70 \times 10^{-9}$
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**Answer Key:**

1. B
2. C
3. A
4. D
5. A
6. D
7. B
8. D
9. C
10. B
11. D
12. C
13. B
14. A
15. A
16. A
17. D
18. B
19. A
20. C
21. C
22. B
23. D
24. B
25. A
26. C