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1. Determine the pH of a 0.100 M NaCN solution.  $K_b(\text{CN}^-) = 2.0 \times 10^{-5}$
- A. 6.85  
B. 8.47  
C. 10.42  
D. 11.15

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2. Which one of the following aqueous solutions has  $\text{pH} < 7.0$ ?
- A.  $\text{CH}_3\text{NH}_3\text{Br}$   
B.  $\text{NaC}_2\text{H}_3\text{O}_2$   
C.  $\text{KNO}_3$   
D.  $\text{LiClO}$

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3. Consider the polyprotic acid  $\text{H}_2\text{C}_2\text{O}_4$  (oxalic acid). Which of the following is **true**?
- A.  $K_{a1} > K_{a2}$   
B.  $K_{a1} < K_{a2}$   
C.  $K_{a1} = K_{a2}$   
D. Not enough information is given to provide an answer.

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4. Which lists the binary compounds in order of **increasing** acidity?
- A.  $\text{HI} < \text{H}_2\text{Se} < \text{H}_2\text{S} < \text{LiH}$   
B.  $\text{LiH} < \text{HI} < \text{H}_2\text{Se} < \text{H}_2\text{S}$   
C.  $\text{LiH} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{HI}$   
D.  $\text{H}_2\text{S} < \text{H}_2\text{Se} < \text{LiH} < \text{HI}$

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5. Which of the following is the **strongest** oxyacid?
- A.  $\text{HClO}$   
B.  $\text{HClO}_2$   
C.  $\text{HClO}_3$   
D.  $\text{HClO}_4$
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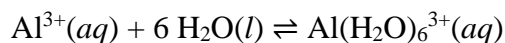
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6. Which one of the following is the **strongest** Lewis acid?



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7. Which statement is **true** for the reaction below?



A.  $\text{H}_2\text{O}$  is a Lewis acid; it is an electron pair donor.

B.  $\text{H}_2\text{O}$  is a Lewis acid; it is an electron pair acceptor.

C.  $\text{Al}^{3+}$  is a Lewis acid; it is an electron pair acceptor.

D.  $\text{Al}^{3+}$  is a Lewis base; it is an electron pair donor.

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8. Which one of the following combinations acts as a buffer?

A. 0.20 M HBr and 0.10 M  $\text{Ba}(\text{OH})_2$

C. 0.20 M NaCN and 0.20 M  $\text{HC}_2\text{H}_3\text{O}_2$  (acetic acid)

B. 0.25 M  $\text{NH}_3$  and 0.30 M  $(\text{CH}_3)_2\text{NH}$

D. 0.45 M  $\text{HCHO}_2$  (formic acid) and 0.50 M  $\text{NaCHO}_2$

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9. Determine the pH of a buffer solution that is 0.050 M acetic acid ( $\text{HC}_2\text{H}_3\text{O}_2$ ) and 0.150 M sodium acetate ( $\text{NaC}_2\text{H}_3\text{O}_2$ ).  $K_a(\text{HC}_2\text{H}_3\text{O}_2) = 1.8 \times 10^{-5}$

A. 3.21

C. 4.74

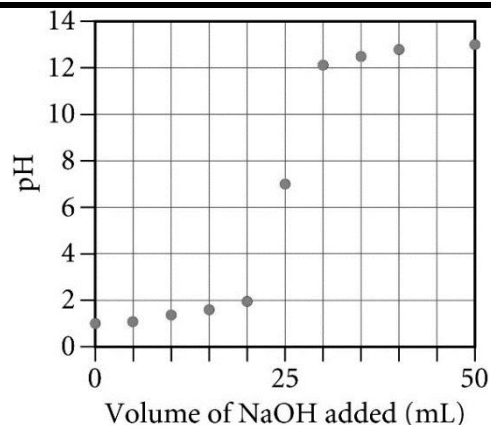
B. 4.33

D. 5.22

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14. The plot shows the titration of a strong acid with a strong base. At the equivalence point, which of the following is **true**?



- A.  $\text{mol H}_3\text{O}^+ = \text{mol OH}^-$   
B.  $\text{mol H}_3\text{O}^+ > \text{mol OH}^-$   
C.  $\text{mol H}_3\text{O}^+ < \text{mol OH}^-$   
D. The resulting solution is a buffer.
15. A 100-mL buffer solution contains 0.350 M lactic acid ( $\text{HC}_3\text{H}_5\text{O}_3$ ) and 0.250 M sodium lactate ( $\text{NaC}_3\text{H}_5\text{O}_3$ ). What is the pH when 5.00 mL of 3.00 M KOH has been added?  $\text{p}K_a(\text{HC}_3\text{H}_5\text{O}_3) = 3.85$
- A. 2.36  
B. 3.85  
C. 4.15  
D. 8.56

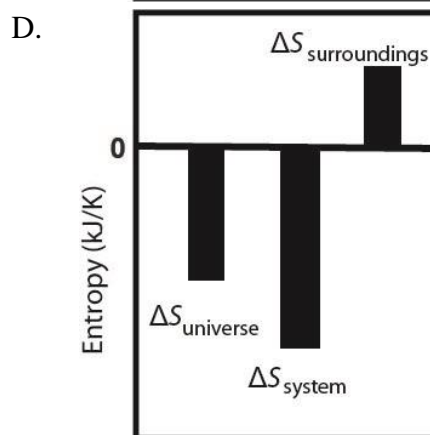
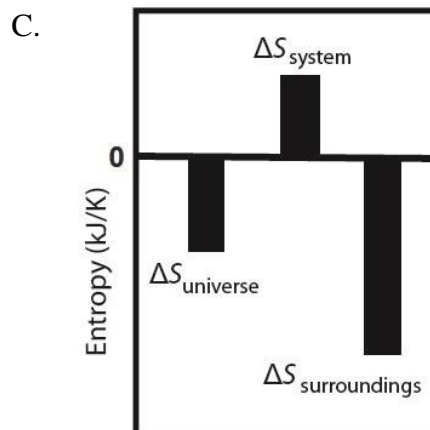
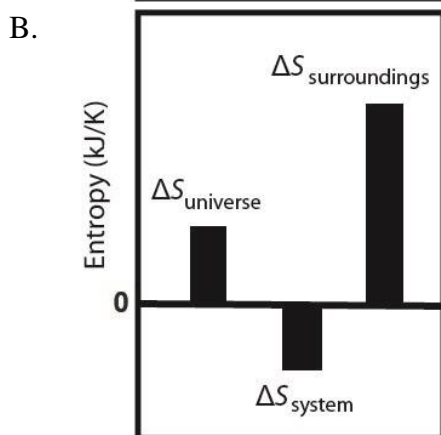
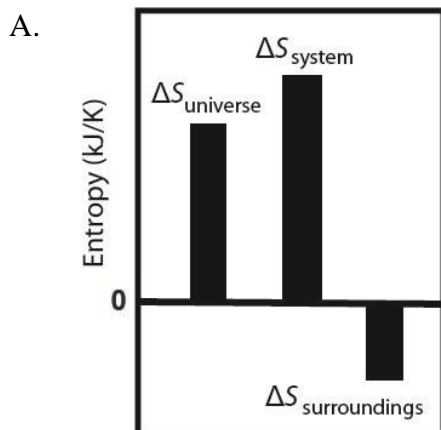
16. What is the pH after mixing 30.0 mL of 0.100 M HCl with 25.0 mL of 0.100 M NaCN?  
 $K_b(\text{CN}^-) = 2.0 \times 10^{-5}$
- A. 4.25  
B. 3.22  
C. 2.04  
D. 1.56

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17. One type of indicator is a weak acid that is a different color than its conjugate base. Over which pH range will the indicator change color?
- A.  $\text{pH} = \text{p}K_a (\text{indicator}) \pm 1$                       C.  $\text{pH} = \text{p}K_a (\text{indicator}) \pm 0.1$   
B.  $\text{pH} = \text{p}K_a (\text{indicator}) \pm 10$                       D.  $\text{pH} = \text{p}K_a (\text{indicator})$
- 
18. Which of the following salts is the **most** soluble in pure water?
- A.  $\text{CdCO}_3, K_{\text{sp}} = 1.0 \times 10^{-12}$                       C.  $\text{BaCO}_3, K_{\text{sp}} = 2.6 \times 10^{-9}$   
B.  $\text{FeCO}_3, K_{\text{sp}} = 3.1 \times 10^{-11}$                       D.  $\text{MgCO}_3, K_{\text{sp}} = 6.8 \times 10^{-6}$
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19. Determine the molar solubility of  $\text{BaF}_2$  in pure water.  $K_{\text{sp}} (\text{BaF}_2) = 2.45 \times 10^{-5}$
- A. 0.561 M                      C.  $5.36 \times 10^{-3}$  M  
B.  $1.83 \times 10^{-2}$  M                      D.  $4.43 \times 10^{-4}$  M
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20. In which aqueous solution is  $\text{SrSO}_4(\text{s})$  **most** soluble?  $K_{\text{sp}} (\text{SrSO}_4) = 3.4 \times 10^{-7}$
- A. 0.10 M  $\text{Sr}(\text{NO}_3)_2$                       C. 0.10 M  $\text{Na}_2\text{SO}_4$   
B. 0.10 M  $\text{KNO}_3$                       D. 0.10 M  $\text{H}_2\text{SO}_4$
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21. The solubility of  $\text{Mg}(\text{OH})_2$  **increases** with
- A. increasing pH.                      C. decreasing pOH.  
B. decreasing pH.                      D. increasing concentration of  $\text{Mg}^{2+}(\text{aq})$ .
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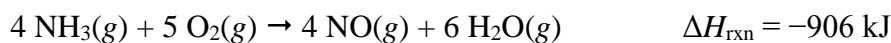




28. Which chart best represents the spontaneous condensation of  $\text{H}_2\text{O}(g)$  to  $\text{H}_2\text{O}(l)$ ?



29. Determine the entropy change in the surroundings for the following reaction at  $25.0\text{ }^\circ\text{C}$ :



A.  $+6.95 \text{ kJ/K}$

C.  $-1.14 \text{ kJ/K}$

B.  $+3.04 \text{ kJ/K}$

D.  $-2.82 \text{ kJ/K}$

30. A  $0.1255 \text{ g}$  sample of an unknown monoprotic acid was titrated with  $0.0450 \text{ M KOH}$ . The equivalence point occurs at  $20.20 \text{ mL}$ . What is the molar mass of the unknown acid?

A.  $122 \text{ g/mol}$

C.  $148 \text{ g/mol}$

B.  $138 \text{ g/mol}$

D.  $180. \text{ g/mol}$



**Answer Key:**

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