

These problems are intended to *supplement* the problems in the textbook, not *replace* them.

**Data:**

<i>Acids</i>				
<i>Name</i>	<i>Formula</i>	$K_{a1}$	$K_{a2}$	$K_{a3}$
acetic acid	HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>	$1.8 \times 10^{-5}$	x	x
ascorbic acid	H <sub>2</sub> C <sub>6</sub> H <sub>6</sub> O <sub>6</sub>	$8.0 \times 10^{-5}$	$1.6 \times 10^{-12}$	x
benzoic acid	HC <sub>7</sub> H <sub>5</sub> O <sub>2</sub>	$6.3 \times 10^{-5}$	x	x
carbonic acid	H <sub>2</sub> CO <sub>3</sub>	$4.3 \times 10^{-7}$	$5.6 \times 10^{-11}$	x
citric acid	H <sub>3</sub> C <sub>6</sub> H <sub>5</sub> O <sub>7</sub>	$7.4 \times 10^{-4}$	$1.7 \times 10^{-5}$	$4.0 \times 10^{-7}$
cyanic acid	HCNO	$3.5 \times 10^{-4}$	x	x
hydrocyanic acid	HCN	$4.9 \times 10^{-10}$	x	x
hydrofluoric acid	HF	$6.8 \times 10^{-4}$	x	x
hypochlorous acid	HClO	$3.0 \times 10^{-8}$	x	x
hypobromous acid	HBrO	$2.5 \times 10^{-9}$	x	x
hypoiodous acid	HIO	$2.3 \times 10^{-11}$	x	x
lactic acid	HC <sub>3</sub> H <sub>5</sub> O <sub>3</sub>	$1.4 \times 10^{-4}$	x	x
oxalic acid	H <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	$5.9 \times 10^{-2}$	$6.4 \times 10^{-5}$	x
phosphoric acid	H <sub>3</sub> PO <sub>4</sub>	$7.5 \times 10^{-3}$	$6.2 \times 10^{-8}$	$4.2 \times 10^{-13}$
sulfurous acid	H <sub>2</sub> SO <sub>3</sub>	$1.7 \times 10^{-2}$	$6.4 \times 10^{-8}$	x

<i>Bases</i>		
<i>Name</i>	<i>Formula</i>	$K_b$
ammonia	NH <sub>3</sub>	$1.8 \times 10^{-5}$
aniline	C <sub>6</sub> H <sub>5</sub> NH <sub>2</sub>	$4.3 \times 10^{-10}$
butylamine	C <sub>4</sub> H <sub>9</sub> NH <sub>2</sub>	$5.9 \times 10^{-4}$
dimethylamine	(CH <sub>3</sub> ) <sub>2</sub> NH	$5.4 \times 10^{-4}$
ethylamine	C <sub>2</sub> H <sub>5</sub> NH <sub>2</sub>	$6.4 \times 10^{-4}$
hydroxylamine	NH <sub>2</sub> OH	$1.1 \times 10^{-8}$
methylamine	CH <sub>3</sub> NH <sub>2</sub>	$4.4 \times 10^{-4}$
pyridine	C <sub>5</sub> H <sub>5</sub> N	$1.7 \times 10^{-9}$
trimethylamine	(CH <sub>3</sub> ) <sub>3</sub> N	$6.4 \times 10^{-5}$

**Questions**

1. What is the pH of a 0.0459 M HBr solution?
2. What is the pH of a solution with a pOH of 9.67?
3. What is the pH of a 0.024 M Ba(OH)<sub>2</sub> solution?
4. What concentration of HCl gives a pH of 1.23?
5. How many grams of HNO<sub>3</sub> do you need in 500.0 mL of solution to make the pH = 2.57?
6. What concentration of NaOH gives a pH of 10.92?
7. What concentration of Sr(OH)<sub>2</sub> gives a pOH of 4.32?
8. What concentration of HClO<sub>4</sub> gives a pOH of 12.34?
9. How many grams of KOH are needed to give a pH of 11.98 in 4.00 L of solution?

**Write the formula and give the name for the conjugate acid of each of these bases.**

- |   |   |   |
|---|---|---|
| 10. methylamine, $\text{CH}_3\text{NH}_2$         | 13. fluoride, $\text{F}^-$                  | 16. trimethylamine, $(\text{CH}_3)_3\text{N}$ |
| 11. butylamine, $\text{C}_4\text{H}_9\text{NH}_2$ | 14. hydroxide, $\text{OH}^-$                | 17. water, $\text{H}_2\text{O}$               |
| 12. carbonate, $\text{CO}_3^{2-}$                 | 15. hydrogen phosphate, $\text{HPO}_4^{2-}$ |   |

**Write the formula and give the name for the conjugate base of each of these acids.**

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|--|---|--|
| 18. cyanic acid, $\text{HCNO}$                         | 21. hydronium, $\text{H}_3\text{O}^+$               | 24. water, $\text{H}_2\text{O}$                      |
| 19. arsenic acid, $\text{H}_3\text{AsO}_4$             | 22. hydrogen phosphate, $\text{HPO}_4^{2-}$         |  |
| 20. ethylammonium, $\text{C}_2\text{H}_5\text{NH}_3^+$ | 23. benzoic acid, $\text{HC}_7\text{H}_5\text{O}_2$ | 25. dimethylammonium, $(\text{CH}_3)_2\text{NH}_2^+$ |

**Refer to the Data given on the first page to determine the indicated dissociation constant for each of the following at 25 °C.**

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|--|---|---|
| 26. $K_a$ for $\text{H}_2\text{C}_6\text{H}_5\text{O}_7^-$ | 29. $K_b$ for $\text{CNO}^-$              | 32. $K_a$ for $\text{C}_5\text{H}_5\text{NH}^+$ |
| 27. $K_b$ for $\text{H}_2\text{C}_6\text{H}_5\text{O}_7^-$ | 30. $K_a$ for $\text{HSO}_3^-$            | 33. $K_b$ for $\text{CO}_3^{2-}$                |
| 28. $K_a$ for $\text{C}_6\text{H}_5\text{NH}_3^+$          | 31. $K_b$ for $\text{C}_2\text{O}_4^{2-}$ |   |

### Answers

If you cannot figure out how to get the correct answer, go to your instructor, Science Tutoring Center, etc.

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|---|--|---|
| 1. 1.338  | 12. $\text{HCO}_3^-$ , hydrogen carbonate            | 23. $\text{C}_7\text{H}_5\text{O}_2^-$ , benzoate |
| 2. 4.33   | 13. HF, hydrofluoric acid                            | 24. $\text{OH}^-$ , hydroxide                     |
| 3. 12.68  | 14. $\text{H}_2\text{O}$ , water                     | 25. $(\text{CH}_3)_2\text{NH}$ , dimethylamine    |
| 4. 0.059 M HCl  | 15. $\text{H}_2\text{PO}_4^-$ , dihydrogen phosphate | 26. $1.7 \times 10^{-5}$                          |
| 5. 0.085 g $\text{HNO}_3$                               | 16. $(\text{CH}_3)_3\text{NH}^+$ , trimethylammonium | 27. $1.4 \times 10^{-11}$                         |
| 6. $8.3 \times 10^{-4}$ NaOH                            | 17. $\text{H}_3\text{O}^+$ , hydronium               | 28. $2.3 \times 10^{-5}$                          |
| 7. $2.4 \times 10^{-5}$ M $\text{Sr}(\text{OH})_2$      | 18. $\text{CNO}^-$ , cyanate                         | 29. $2.9 \times 10^{-11}$                         |
| 8. 0.022 M $\text{HClO}_4$                              | 19. $\text{H}_2\text{AsO}_4^-$ , dihydrogen arsenate | 30. $6.4 \times 10^{-8}$                          |
| 9. 2.1 g KOH  | 20. $\text{C}_2\text{H}_5\text{NH}_2$ , ethylamine   | 31. $1.6 \times 10^{-10}$                         |
| 10. $\text{CH}_3\text{NH}_3^+$ , methylammonium         | 21. $\text{H}_2\text{O}$ , water                     | 32. $5.9 \times 10^{-6}$                          |
| 11. $\text{C}_4\text{H}_9\text{NH}_3^+$ , butylammonium | 22. $\text{PO}_4^{3-}$ , phosphate                   | 33. $1.8 \times 10^{-4}$                          |