

CH142 Exam 1
Spring 2019
Answer Key

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

11.

- A) Lewis Acid
- B) Lewis Base
- C) Neither
- D) Lewis Acid

12.

- A) Acidic
- B) Neutral
- C) Acidic
- D) Basic

13.

- A) Decreases
- B) Increases
- C) Stays the same

14.

- A) $\text{HY}^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{Y} + \text{OH}^-$
- B) $\text{HY}^- + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{Y}^{2-}$
- C) acidic

15.

A) $K_a = [\text{H}_3\text{O}^+][\text{A}^-]/[\text{HA}] = 3.0 \times 10^{-8}$

Need an ICE table.

	$[\text{HA}]$	$[\text{H}_3\text{O}^+]$	$[\text{A}^-]$
I	0.70 M	0	0
C	-x	+x	+x
E	0.70 - x	x	x

$$K_a = x^2 / [0.70 - x] = 3.0 \times 10^{-8}$$

Easiest way to solve is to ignore x in the denominator.

$$K_a = x^2 / 0.70 = 3.0 \times 10^{-8}$$

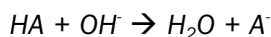
$$x = 1.5 \times 10^{-4} \text{ M.}$$

$$\% \text{ dissociation} = 1.5 \times 10^{-4} / 0.70 \times 100 = 0.021\%$$

B) After 100 mL added:

$$0.7 \text{ mol/L} \times 0.1 \text{ L} = 0.07 \text{ mol HA initially}$$

$$0.7 \text{ mol/L} \times 0.1 \text{ L} = 0.07 \text{ mol OH}^- \text{ added}$$



$$\text{mol HA at equilibrium} = 0.07 \text{ mol} - 0.07 \text{ mol} = 0 \text{ mol}$$

$$\text{mol A}^- \text{ at equilibrium} = 0.07 \text{ mol}$$

$$\text{This is a weak base problem, with } [\text{A}^-] = 0.07 \text{ mol} / 0.2 \text{ L} = 0.35 \text{ M}$$

$$x^2 / 0.35 - x = 3.33 \times 10^{-7} (K_b)$$

$$x = 3.4 \times 10^{-4} = [\text{OH}^-], \text{ so } \text{pOH} = 3.47, \text{ so } \text{pH} = 10.53$$

$$16. K_{sp} = [\text{Pb}^{2+}][\text{Cl}^-]^2$$

$$[\text{Pb}^{2+}] = 0.032 \text{ M} / 2 = 0.016 \text{ M}; [\text{Cl}^-] = 0.020 \text{ M} / 2 = 0.010 \text{ M}$$

$$Q = 0.016 \times (0.010)^2 = 1.6 \times 10^{-6}; Q < K. \quad \text{NO}$$

Note that a very common error was not to account for the dilution when the solutions were mixed in equal volumes (factor of 2 dilution).

17.

A) You need solid Tris base, HCl, and water.

$$\text{B) Tris needed: } 0.1 \text{ mol/L} \times 1 \text{ L} \times 121.1 \text{ g/mol} = \mathbf{12 \text{ g Tris}}$$

$$\text{pH} = \text{pK}_a + \log [\text{A}^-] / [\text{HA}]$$

$$8.58 = 8.1 + \log [\text{A}^-] / [\text{HA}] \quad (\text{Note that } \text{pK}_a = \text{pK}_w - \text{pK}_b = 14 - 5.9 = 8.1)$$

$$\log [\text{A}^-] / [\text{HA}] = 0.48, \text{ so } [\text{A}^-] / [\text{HA}] = 3$$

So for every 3 A^- , we need 1 HA. Or of every 4 Tris molecules, 3 are A^- and 1 is HA.

We started with all A^- , so we need to titrate $\frac{1}{4}$ of it to HA.

$$0.1 \text{ mol} \times 0.25 = 0.025 \text{ mole of HCl needed.}$$

$$\text{HCl is } 1 \text{ M, so we need } 0.025 \text{ L, or } \mathbf{25 \text{ mL HCl.}}$$

Add **975 mL H_2O** to get to 1.0 liters of the buffer.