

Exam 1 Answer Key

Problem 1

Part A

$$K_{sp} = [Ag^+]^2[CrO_4^{2-}] = 1.2 \times 10^{-12}$$

$$X = [CrO_4^{2-}] \quad 2X = [Ag^+]$$

$$(2X)^2 \cdot X = K_{sp} = 1.2 \times 10^{-12}$$

$$(4X)^3 = K_{sp} = 1.2 \times 10^{-12}$$

$$X = \sqrt[3]{\frac{1.2 \times 10^{-12}}{4}}$$

$$X = 6.69 \times 10^{-5} \text{ M} = [CrO_4^{2-}] \quad [Ag^+] = 2X$$

$$[Ag^+] = 1.34 \times 10^{-4} \text{ or } 1.3 \times 10^{-4} \text{ (sig. fig.)}$$

Part B

$$[CrO_4^{2-}] = \frac{2.5000 \text{ grams}}{194.188 \text{ grams/mole}} = 1.287 \times 10^{-2} \text{ Moles}$$

$$\text{Volume} = 0.10000 \text{ Liters} \quad \text{Molarity} = \frac{1.287 \times 10^{-2} \text{ Moles}}{0.10000 \text{ Liters}} = 0.1287 \text{ M}$$

$$K_{sp} = 1.2 \times 10^{-12} = [2x]^2[x + 0.1287 \text{ M}]$$

assume x is small compared to 0.1287 M so equation becomes:

$$K_{sp} = 1.2 \times 10^{-12} = [2x]^2[0.1287 \text{ M}]$$

$$K_{sp} = 1.2 \times 10^{-12} = 4x^2 \cdot [0.1287 \text{ M}]$$

$$X = 1.5265 \times 10^{-6}$$

$$X = [CrO_4^{2-}] \quad 2X = [Ag^+]$$

$$[Ag^+] = 3.1 \times 10^{-6} \text{ M (2 sig. fig.)}$$

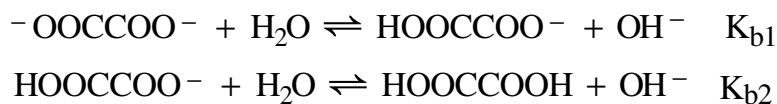
Problem 2

Part a)

The conjugate bases for oxalic acid are:



so the base association reactions are:



Part b)

$$K_{b1} = \frac{K_w}{K_{a2}} \quad K_{b2} = \frac{K_w}{K_{a1}}$$

$$K_{b1} = \frac{1.00 \times 10^{-14}}{5.42 \times 10^{-5}} = 1.85 \times 10^{-10}$$

$$K_{b2} = \frac{1.00 \times 10^{-14}}{5.60 \times 10^{-2}} = 1.79 \times 10^{-13}$$

Problem 3

$$[(227.45 \pm 0.51) - (103.27 \pm 0.12)]$$

$$[(23.20 \pm 0.09) - (14.75 \pm 0.09) + (2.02 \pm 0.05)]$$

solving top and bottom parts the problem becomes:

$$\frac{124.18 \pm 0.5239}{10.47 \pm 0.1367}$$

Converting to relative errors:

$$\frac{124.18 \pm 0.4219 \%}{10.47 \pm 1.306 \%}$$

which becomes:

$$11.86 \pm 1.372 \%$$

and for absolute error

$$11.86 \pm 0.1627$$

expressing to correct sig. fig. becomes

$$11.86 \pm 0.16$$

if you used the "real rule" and expressed as:

$$11.9 \pm 0.2$$

I also would give you credit as correct

I may not have done this on all exams, I will regrade
if you think I didn't give you credit for using the "real rule"
just return your exam to me

Problem 4

The answer is (c) precise (all numbers are very close to one another with a small standard deviation of 0.3 ppb) but not accurate (averaged values have an error of 25.1 ppb or 44%).

Problem 5

Part a

$$\text{wt.}\% = (\text{weight of CuCl}_2 / \text{weight of solution}) \times 100$$

$$\begin{aligned} \text{wt. solution} &= (\text{volume})(\text{density}) = (1.06 \text{ g/mL})(100.00 \text{ mL}) \\ &= 106 \text{ grams} \end{aligned}$$

$$\text{wt.}\% = \frac{1.3207 \text{ g}}{106 \text{ g}} \times 100 = 1.25\%$$

Part b

$$\text{molarity} = \text{moles/liter}$$

$$\text{moles} = \frac{1.3207 \text{ g}}{134.45 \text{ g/mole}} = 9.8229_8 \times 10^{-3} \text{ moles}$$

$$\text{volume} = 0.10000 \text{ Liters}$$

$$\text{Molarity} = \frac{9.8229_8 \times 10^{-3} \text{ moles}}{0.10000 \text{ Liters}} =$$

$$9.8229_8 \times 10^{-2} \text{ M}$$

to 5 sig. figs with rounding

$$9.8230 \times 10^{-2} \text{ M}$$

Problem 6

a) weak acid b) strong base c) strong acid d) weak base e) strong base

Problem 7

$$t_{95\%} = 2.571 \text{ for } 5 \text{ degrees of freedom } (n-1)$$

$$t_{99\%} = 4.032 \text{ for } 5 \text{ degrees of freedom } (n-1)$$

$$\mu = \bar{X} \pm \frac{ts}{\sqrt{n}}$$

$$\bar{X} = 174.0 \quad S = 6.1 \quad n = 6$$

$$\mu_{95\%} = 174 \pm 6.4$$

$$\mu_{99\%} = 174 \pm 10.0$$

Problem 8

Need to reduce 0.25 M $[\text{Ag}^+]$ to .01% = $(0.25 \text{ M}) \times (0.0001) = 2.5 \times 10^{-5} \text{ M}$

$$K_{\text{sp}} = 3.5 \times 10^{-11} = [\text{Ag}^+]^2[\text{C}_2\text{O}_4^{2-}]$$

$$[\text{Ag}^+] = 2.5 \times 10^{-5} \text{ M}$$

rearranging and plugging in $[\text{Ag}^+]$

$$[\text{C}_2\text{O}_4^{2-}] = \frac{(3.5 \times 10^{-11})}{(2.5 \times 10^{-5})^2} = 0.056 \text{ M}$$