Chemistry 255
Spring 2011
Problem Set #6
Answer Key

1. $\frac{7.42.\text{mg}}{275\text{mL}} = \frac{7.42\times10^{-3}\,\text{g}}{0.275\text{L}} \times \frac{\text{mol}}{374\text{g}} = 7.214\times10^{-5}\,\text{M}$

a) $A = -\log T$

$A = \varepsilon bc$

$$\varepsilon = \frac{-\log(0.374)}{(1.25\text{cm})(7.214\times10^{-5}\,\text{M})} = 4.73\times10^{3}\,\text{M}^{-1}\text{cm}^{-1}$$

b) $-\log T = A$

$-\log(0.824) = 0.0841$

$0.0841 = (4.73\times10^{3})(1.25)c$

$c = 1.42\times10^{-5}\,\text{M}$

2. $A = \varepsilon bc$

Bottle 1: $0.057 = \varepsilon(1.25)(7.24\times10^{-6})$ $\qquad \varepsilon = 6.298\times10^{3}\,\text{M}^{-1}\text{cm}^{-1}$

Bottle 2: $\frac{0.143}{(1.82\times10^{-5})(1.25)} = \varepsilon$ $\qquad \varepsilon = 6.285\times10^{3}\,\text{M}^{-1}\text{cm}^{-1}$

Bottle 3: $\frac{0.272}{(3.81\times10^{-5})(1.25)} = \varepsilon$ $\qquad \varepsilon = 5.711\times10^{3}\,\text{M}^{-1}\text{cm}^{-1}$

Bottle 4: $\frac{0.417}{(5.31\times10^{-5})(1.25)} = \varepsilon$ $\qquad \varepsilon = 6.282\times10^{3}\,\text{M}^{-1}\text{cm}^{-1}$

All but bottle #3 are correct. It could be some other compound, or ferrocene could be there in a different concentration. The correct concentration of ferrocene would be :

$$c = \frac{A}{\varepsilon b} = \frac{0.272}{(6.288\times10^{3}\,\text{M}^{-1}\text{cm}^{-1})(1.25\text{cm})} = 3.46\times10^{-5}\,\text{M}$$

3.$A = \varepsilon bc$

1st Solution : $c = 6.15\times10^{-6}\,M, b = 1.00cm, A = 0.234$

$$\varepsilon = \frac{A}{bc} = \frac{0.234}{(1.00)(6.15\times10^{-6})} = 3.805\times10^{4}\,M^{-1}cm^{-1}$$

2nd Solution : $A = 0.401$

$$c = \frac{A}{\varepsilon b} = \frac{0.401}{(3.805\times10^{4})(1.00)} = 1.054\times10^{-5}\,M$$

1st Solution

$$(6.15\times10^{-6}\ mol/L)(0.450L) = 2.768\times10^{-6}\,moles$$

2nd Solution

$$(1.054\times10^{-5}\ mol/L)(0.250L) = 2.635\times10^{-6}\,moles$$

$$\text{total} : \frac{2.768\times10^{-6}\,moles + 2.635\times10^{-6}\,moles}{0.700L} = 7.718\times10^{-6}\,M$$

$$A = \varepsilon bc = (3.805\times10^{4}\,M^{-1}cm^{-1})(1.00cm)(7.718\times10^{-6}\,M) = 0.294$$

4. Mixture : $A'_{254} = 0.692$ $A''_{528} = 0.417$

| $\lambda$ | $\varepsilon$(A) | $\varepsilon$(B) |
|---|---|---|
| 254 nm(') | 2,763 | 12,692 |
| 528 nm(") | 9,842 | 3,734 |

$$[A] = \frac{\begin{vmatrix} 0.692 & 12692 \\ 0.417 & 3734 \end{vmatrix}}{\begin{vmatrix} 2763 & 12692 \\ 9842 & 3734 \end{vmatrix}} = \left|\frac{(2583.928 - 5292.564)}{(10317042 - 124914664)}\right| = 2.36\times10^{-5}\,M = [A]$$

$$[B] = \frac{\begin{vmatrix} 2763 & 0.692 \\ 9842 & 0.417 \end{vmatrix}}{\begin{vmatrix} 2763 & 12692 \\ 9842 & 3734 \end{vmatrix}} = \left|\frac{-5658.493}{-1.14598\times10^{8}}\right| = 4.94\times10^{-5}\,M = [B]$$

5. $\frac{A_m}{A_{Cx}} = \frac{[D]}{[D]_s}(\frac{A_{Ds}}{A_{Cs}}) + \frac{[C]}{[C]_s}$

Plot the following data :

| λ | $\text{Abs D}/\text{Abs C}$ (x - axis) | $\text{Abs mix}/\text{Abs C}$ (y - axis) |
|---|---|---|
| 214 | 0.2010 | 0.5295 |
| 254 | 1.0943 | 1.2830 |
| 290 | 0.50275 | 0.7798 |
| 328 | 1.5766 | 1.6396 |
| 450 | 1.3987 | 1.5518 |
| 528 | 0.6999 | 0.9470 |
| 554 | 1.9019 | 1.9462 |

Equation of line : $y = 0.8286x + 0.3666$

$\frac{[C]}{4.28\times10^{-3}} = 0.3666; \quad [C] = 1.57\times10^{-3}\ \text{M}$ $\frac{[D]}{1.12\times10^{-2}} = 0.8286; \ [D] = 9.28\times10^{-3}\ \text{M}$

6. $\frac{[Cu^{2+}]_{init}}{[Cu^{2+}]_{final} + [\text{Standard}]_{final}} = \frac{A_{init}}{A_{final}}$

$$\frac{[Cu^{2+}]_{init}}{(\frac{95}{100})[Cu^{2+}]_{init} + (\frac{1}{100})(100\,ppm)} = \frac{0.262}{0.500}$$

$$\frac{[Cu^{2+}]_{init}}{(0.95)[Cu^{2+}]_{init} + 1.00} = 0.524$$

$[Cu^{2+}]_{init} = 0.498[Cu^{2+}]_{init} + 0.524$

$0.502[Cu^{2+}]_{init} = 0.524$

**$[Cu^{2+}]$ = 1.04 ppm**