

1. a. $y = \log [(2.00 \pm 0.01) \times 10^{-3}] = ?$
 b. $y = 5 \pi (3.12 \pm 0.03)^4 = ?$ 14%
2. A solution contains 0.0500 M Ca^{2+} and 0.0300 M Ag^+ . Can 99.00% of either ion be precipitated by addition of sulfate without precipitating the other metal ion? What will be the concentration of Ca^{2+} when Ag_2SO_4 begins to precipitate? $K_{sp}(\text{Ag}_2\text{SO}_4) = 1.5 \times 10^{-5}$, $K_{sp}(\text{CaSO}_4) = 2.4 \times 10^{-5}$. 14%
3. Drugs often absorb strongly in the uv. As an example, $\epsilon_{254} = 16000$ and $\epsilon_{267} = 19000$ for tetracycline, while $\epsilon_{254} = 16000$ and $\epsilon_{267} = 15000$ for epi-tetracycline, an inactive hydrolysis product. If a mixture exhibits absorbances of 0.402 at 254 nm and 0.432 at 267 nm, what is the concentration of each compound? 14%
4. If the $^3\text{P}_{2,1,0}$ states of Hg are thermally populated in a flame at 3000 K, calculate the ratio of the populations of the $^3\text{P}_2$ and $^3\text{P}_0$ levels. The splitting is 6398 cm^{-1} . Boltzmann constant, $k = 1.38 \times 10^{-16} \text{ erg K}^{-1}$, $1 \text{ cm}^{-1} = 1.986 \times 10^{-16} \text{ erg}$. 14%
5. The dissociation of the complex between thorium and quercetin can be expressed as $\text{ThQ}_2 \longleftrightarrow \text{Th} + 2\text{Q}$ (omitting formal charges). For a solution that was $2.30 \times 10^{-5} \text{ M}$ in thorium and contained a large excess of quercetin, sufficient to ensure that all of the thorium is present as the complex, the absorbance was 0.780. When the same amount of thorium is mixed with a stoichiometric amount of quercetin, the absorbance was 0.520. Calculate (a) the degree of dissociation and (b) the value of the formation constant of the complex. 14%
6. a. A chromatography column with a length of 10.3 cm and inner diameter of 4.61 mm is packed with a stationary phase that occupies 70.0% of the volume. If the volume flow rate is 1.13 mL/min, find the linear flow rate in cm/min.
 b. How long does it take for solvent which is the same as unretained solute to pass through the column?
 c. Find the retention time for a solute with a capacity factor of 10.0. 15%
7. a. Beer's law can be used to describe the absorption behavior of a compound. Write down the equation of Beer's law. 3%
 b. If the transmittance of the compound is measured with an uncertainty, σ_T , derive how this uncertainty is propagated to the measured uncertainty of concentration.
 c. A spectrophotometric analysis was performed with a manual instrument that exhibited an absolute standard deviation of $\pm 0.003T$ throughout its transmittance scale. Calculate the relative standard deviation in concentration that results from this uncertainty when the analyte solution has an absorbance of 1.000. 6% each for b and c.