Chem 2990 **Dilution Problems** Dr. Walker

1. Standard hydrochloric acid (HCl) reagent is 12.0 M. Describe how to prepare 500 mL of 0.100 M HCl.

2. Standard sulfuric acid (H_2SO_4) reagent is 18.0 M. Describe how to prepare 2.0 L of 1.5 N H_2SO_4.

3. Aqua regia is a strong acid used to dissolve noble metals such as Au and Pt. It is prepared by slowly mixing nitric acid (16M HNO_3) into hydrochloric acid (12M HCl) at a volume ratio of 1:3. Calculate the concentration of both acids after mixing.

4. A mixed salt solution is prepared by mixing 250mL of 1.2 N NaCl with 750mL of 1.2 N KCl. Calculate the concentrations of Na^+, K^+, and Cl^- in the final mixture.

5. Sodium hydroxide reagent is often supplied as a 50%*(w/w)* liquid solution. What volume of this concentrated reagent solution is required to prepare 1.0 L of 0.5 N NaOH? ($\sigma_{50\%NaOH}$ = 1.53 g/mL)

6. A highly radioactive liquid sample must be diluted to for analysis by scintillation counting, so as not to over-saturate the detector. This was accomplished by serial dilution: 20µL of the original sample was first diluted to 250mL with solvent. From this resulting solution, 300µL was transferred to a 100mL volumetric flask and mixed with solvent to the mark. In a third step, 50µL is diluted to a final volume of 100mL. Analysis of the diluted sample returned 1580 disintegrations per minute (dpm). Calculate the dilution factor for this series of dilutions. Then, using this factor, calculate the activity of the original solution in dpm.

7. A concentrated blue dye in aqueous solution is tested by diluting 125µL to 100mL, resulting in an absorbance reading of 0.558. In a separate dilution of the same solution, a spike was added. A total of 175µL (125µL + 50µL) of the concentrated dye sample was diluted to 100mL, resulting in an absorbance of 0.853. What is the "spike recovery?" Show your calculations.

8. While fishing one afternoon, a fisherman notices dead fish begin floating by on the surface of the stream. Fortunately, he has a clean 4-liter polyethylene capped bottle! So, he catches a sample of the water and takes it to the university lab for testing. A trace of cyanide (CN^-)is discovered during preliminary testing, so 3.00 liters of the sample is evaporated down to 50mL and analyzed again. This time, cyanide is present at a concentration of 6.82 ppt. Calculate the dilution factor and use it to calculate the concentration of cyanide in the initial sample. Unknown to the fisherman and chemists, a truck transporting cyanide to a local mining operation had driven off a bridge upstream, dumping a single box of 100 pounds of sodium cyanide into the stream. How much total water would have to mix with this much solute to dilute it down to only 1ppb NaCN?

9. To calibrate a gas chromatograph for blood alcohol assays, the technician must prepare a standard 0.08%(w/v) alcohol solution. Describe how to prepare 100mL of 0.08%(w/w) from a "140 proof" ethanol-water commercial standard. *Hint: 140 proof = 70%(w/v).* Comment on the total volume of the 0.08%(w/v) calibration standard: Is 100 mL a sufficient volume to allow accurate preparation of the calibration standard… or would 1,000 mL be better? Defend your answer.