

## CHEM 311 Review Questions

1. A solution is prepared by dissolving 0.42 g of the amino acid, analine ( $C_3H_7NO_2$ ) and 0.34 g of ammonium chloride in 1.00 L of distilled water. What is the concentration of organic nitrogen, inorganic nitrogen and total nitrogen in units of mg/L of N?
2. A solution is analyzed for its cadmium concentration. The absorbance of the original sample is recorded on an atomic absorption spectrometer to be 0.204. After a 5.00 mL aliquot of  $2.00 \times 10^{-3}$  M  $Cd^{2+}$  standard solution is added to a 50.00 mL sample of the same solution the absorbance increased to 0.249. Determine the cadmium ion concentration in the original sample and report as ppm.
3. The Federal Government Publication "Sampling for Water Quality" has a table, which lists sample containers, preservatives and maximum permissible storage times. For example, for the analysis of total dissolved lead: the sample must be field filtered into a HDPE plastic bottle and preserved with 2 mL/L of analytical grade  $HNO_3$  (storage time is 6 months). For chlorinated pesticides, the sample is collected in an amber glass container stored at 4 °C and analysis should be done within 7 days. The sample should be adjusted to pH 5-9, if necessary and preserved with analytical grade  $Na_2S_2O_3$  if chlorine is known to be present. Discuss the reasons for the different container materials, and preservative techniques when sampling for lead and chlorinated pesticides.
4. A 300.0 mL water sample was taken from a stream in Mexico city ( $T = 30^\circ C$ ,  $P_T = 0.92$  atm) and analyzed for dissolved oxygen. Using the Winkler method, 58.88 mL of a  $2.42 \times 10^{-3}$  N sodium thiosulfate titrant was required. Calculate the DO in the water and express this as mg/L and % saturation. ( $K_H$  for  $O_2$  at  $30^\circ C = 1.16 \times 10^{-3}$  M atm $^{-1}$ )
5. The total and phenolphthalein alkalinity of a 100.0 mL water sample was determined by titrating with 0.0120 M HCl. It took 1.26 mL of standard acid to reach the phenolphthalein end-point (pH 8.3) and 10.26 mL to reach the total end-point (pH = 4.5). What are the phenolphthalein and total alkalinities expressed as ppm  $CaCO_3$ ?
6. The results of a lake analysis for calcium and magnesium using atomic absorption spectroscopy are as follows: Calcium = 28 ppm (s = 3 ppm) and Magnesium = 9.1 ppm (s = 0.6 ppm). In a separate experiment, the total hardness was determined volumetrically using a standard EDTA titrant. A 50.0 mL lake sample was titrated with  $2.41 \times 10^{-3}$  M EDTA. The volume of EDTA required to reach the end point in three separate titrations were; 24.90, 24.82, 24.98 mL. Calculate the hardness in ppm  $CaCO_3$  from the AAS results and the titration data and estimate the uncertainty in each of these experiment results.

7. A 25.00 mL sample of drinking water is analyzed for its iron content by forming a phenanthroline complex and dilution to 50.0 mL. The absorbance in a 2.00 cm sample cell is 0.113 at 510 nm. To a second 25.0 mL sample is added 5.00 mL of a 5.00 ppm Fe standard solution. After dilution as before, the absorbance in the same sample cell is recorded as 0.287. Calculate the Fe concentration in the original sample.

8. One method that can be applied to the determination of the amount of ammonia resulting from a Kjeldahl digestion involves distilling the  $\text{NH}_3$  into a receiver flask containing a known excess quantity of acid and back-titrating the unreacted acid. The  $\text{NH}_3$  liberated from a 50.0 mL sample solution was distilled into a flask containing 10.00 mL of 0.02140 M HCl. The excess (unreacted) HCl was titrated with 3.26 mL of 0.0198 M NaOH. Calculate the nitrogen concentration as mg/L  $\text{NH}_3 - \text{N}$ .

9. A barge has spilled a load of phenol into a river near its estuary. Three 1.00 L samples are taken from the mouth of the river in containers A, B, and C. Preservatives are added to each container and 20.0 mg of phenol is added to container B at the site. The samples are returned to the laboratory for phenol analysis using a spectrophotometric technique. In the laboratory (just prior to analysis) 20.0 mg of phenol is added to container C. Water from each bottle is analyzed in duplicate as well as a 50.0 mg/L phenol standard using the same procedure. The absorbance of each of the solutions is measured at 500 nm as summarized below.

Container A:	0.332	0.320
Container B:	0.629	0.615
Container C:	0.669	0.673
Standard (50.0 mg/L)	0.874	0.870

- What is the purpose of analyzing the samples in duplicate?
- What is the purpose of adding the phenol to container B at the sampling site?
- Use the average absorbance of the standard to determine the average phenol concentrations in the three containers. Interpret the results.

10. In the analysis of nitrate ion by ion chromatography bromide ion is used as an internal standard. The peak areas are electronically integrated and the output is reported as a current in mA. When an equimolar solution of nitrate and bromide was analyzed the peak areas were recorded as 212 mA and 284 mA, respectively. When a 50.0 mL sample of unknown was analyzed for nitrate ion, 2.00 mL of a 50.0 mM standard solution of bromide was added. The peak areas for nitrate and bromide are recorded as 184 mA and 375 mA, respectively. What is the concentration of nitrate in the original sample?