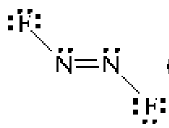
Chemistry 01LA
Solutions to Sample Final Exam Problems

1. Carry out the following calculations, making sure that your answer has the correct number of significant figures:

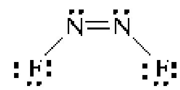
$$\frac{7.78\ \text{mL}}{16.1\ \text{mL} - 8.44\ \text{mL}}$$

$$\frac{7.78\ \text{mL}}{7.\underline{6}6\ \text{mL}} = 1.\underline{0}16\ \text{mL} = 1.0$$

2. Write the Lewis structure for N_2F_2. Draw two isomers and determine whether they are polar or non-polar.



(trans) and

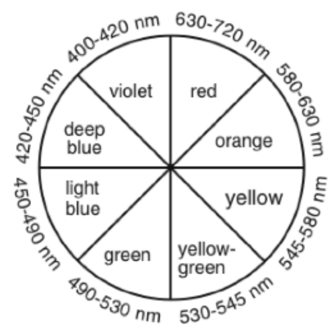


(cis)

The *trans*- isomer is non-polar, while the *cis*- isomer is polar.

3. If the perceived color of a solution is green, what is the approximate wavelength of light that is being absorbed? (Use the color wheel)

if the observed color is green, then the complementary color (red) will be absorbed. The approximate wavelength is between 630 and 720 nm



4. To a crucible and cover weighing 33.392 g is added a sample of a copper (II) chloride hydrate ($CuCl_2 \bullet nH_2O$). The mass of the crucible, cover and contents is 34.405 g. The hydrate sample was heated until all the water was driven off. Upon cooling, the sample plus crucible and cover weighed 33.881 g. The molar mass of anhydrous $CuCl_2$ is 134.456 g/mol.

(a) How many moles of water are in the hydrate?

$$\text{g } H_2O = 34.405\ \text{g} - 33.881\ \text{g} = 0.524\ \text{g}$$

$$0.524\ \text{g } H_2O \times \frac{\text{mol } H_2O}{18.02\ \text{g } H_2O} = 0.02908\ \text{mol } H_2O$$

(b) How many moles of anhydrous $CuCl_2$ are in the hydrate?

$$\text{g } CuCl_2 = 33.881\ \text{g} - 33.392\ \text{g} = 0.489\ \text{g}\ \ (\text{or } 34.405\ \text{g} - 33.392 - 0.524\ \text{g})$$

$$0.489\ \text{g } CuCl_2 \times \frac{\text{mol } CuCl_2}{134.456\ \text{g } CuCl_2} = 0.003637\ \text{mol } CuCl_2$$

(c) What is the formula of the copper (II) chloride hydrate?

$$n = \frac{\text{mol } H_2O}{\text{mol } CuCl_2} = \frac{0.02908\ \text{mol}}{0.003637\ \text{mol}} = 8 \quad \therefore \quad CuCl_2 \cdot 8H_2O$$

5. What is the wavelength of light emitted from the hydrogen atom when an electron undergoes a transition from n=4 to n=2?

$$\frac{1}{\lambda} = R\left(\frac{1}{n_\ell^2} - \frac{1}{n_h^2}\right)$$

$$\frac{1}{\lambda} = 1.1\times10^7\,\mathrm{m}^{-1}\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

$$\frac{1}{\lambda} = 1.1\times10^7\,\mathrm{m}^{-1}\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\frac{1}{\lambda} = 1.1\times10^7\,\mathrm{m}^{-1}\left(\frac{3}{16}\right)$$

$$\lambda = \left(\frac{16}{3}\right)\left(\frac{1}{1.1\times10^7\,\mathrm{m}^{-1}}\right)$$

$$\lambda = 4.85\times10^{-7}\,\mathrm{m}$$

$$\lambda = 485\ \mathrm{nm}$$

6. An empty Erlenmeyer flask weighs 241.3 g. When filled with water (d = 1.00 g/cm^3), the flask and its contents weigh 489.1 g.

(a) What is the volume of the flask?

$$\text{mass of water} = 489.1\ \mathrm{g} - 241.3\ \mathrm{g} = 247.8\ \mathrm{g}$$

$$\mathrm{V\ (cm^3)} = 247.8\ \mathrm{g}\ \mathrm{x}\ \frac{1\ \mathrm{cm^3}}{1.00\ \mathrm{g}} = 248\ \mathrm{cm^3}$$

(b) How much does the flask weigh when filled with chloroform (d = 1.48 g/cm^3)?

$$\mathrm{m\,(g)} = 248\ \mathrm{cm^3}\ \mathrm{x}\ 1.48\ \frac{\mathrm{g}}{\mathrm{cm^3}} = 367.\ \mathrm{g\ chloroform}$$

$$241.3\ \mathrm{g} + 367.\ \mathrm{g} = 608\ \mathrm{g}\ \text{(flask + chloroform)}$$

7. A Cu^{2+} solution obtained by dissolving a 3.1871-g penny in 500 mL of nitric acid has an absorbance of 0.342 at 620 nm in a 1.00 cm cell. The calibration curve prepared from Cu^{2+} solutions of varying concentrations has a slope of 281.8 L/mol and a y-intercept of 0.0106.

(a) Calculate the concentration of the solution in moles per liter.

$$y = mx + b$$

$$0.342 = (281.8\ \mathrm{L/mol})x + 0.0106$$

$$x = (0.342 - 0.0106) / 281.8\ \mathrm{L/mol}$$

$$= 1.18 \times 10^{-3}\ \mathrm{mol/L}$$

(b) Calculate the percent Cu by mass in the penny

moles Cu = $(1.18 \times 10^{-3}$ mol/L)(0.500 L) = 5.90×10^{-4} mol

mass Cu = 5.90×10^{-4} mol Cu (63.55 g Cu/mol Cu) = 0.0375 g Cu

percent Cu in penny = (0.0375 g / 3.1871 g) × 100%
= 1.18 % Cu