Week 3 Worksheet

Chem 11200-2: Section 33

Jan. 25, 2022

Remarks: The following information might be useful.

1. T_f of benzene is 5.50 °C
2. K_f of benzene is 4.9 K kg/mol
3. Density of benzene is 0.8765 g/mL

***Problem* 1:** Consider the following reaction

$$H_3PO_4\,(aq) + NaOH\,(aq) \longrightarrow Na_3PO_4\,(aq) + H_2O\,(l)$$

a) Balance the chemical equation above.

b) How many grams of sodium phosphate will form when 50.0 mL of 0.280 M H_3PO_4 solution are added to 80.0 mL of 0.370 M NaOH solution?

***Problem* 2:** How many grams of lithium sulfate must be used to prepare 500.0 mL of a 0.950 M solution?

***Problem* 3:** 1.2 L of water is added to 700.0 mL of a 6.0 M LiBr solution. What is the new concetration?

The following problem comes from my own personal research and represents the utility of knowing how to make solutions in any area of science.

***Problem* 4:** A very common solution used in biology and biochemistry labs is a phosphate buffered saline (PBS). This buffer mimics the pH, osmolarity, and ion concentrations within the human body and is routinely used to wash cells and tissues. This is typically made as 10x PBS and then diluted down to 1x PBS working solution via a 1:10 dilution. The 10x PBS solutions contains 1.37 M NaCl, 27 mM KCl, 100 mM Na_2HPO_4, and 18 mM KH_2PO_4.

a) How much of each compound should be weighed out to make a 1L solution of 10X PBS?

b) What is the concentration of each component in the 1X working solution?

***Problem* 5:** Your summer internship at a biomineralization pathology research lab has started and several tissue samples have been received from the adjacent hospital. Your PI wants to process these tissues for histology which means thinly slicing the tissue onto slides; however all of the samples contain bone in them and you cannot cut through it.

a) After fixing the samples in 10% formalin overnight and washing with PBS you want to begin the demineralization process but realize that your colleagues have used up the rest of your 0.5 M EDTA solution! You rush to quickly make 1L of solution. In your lab you find only $\mathrm{EDTA \cdot Na_2 \cdot 2\,H_2O}$ ($MW = 372.24$). **How much EDTA do you need to weigh out to make your solution?**

Typically this solution is further buffered to a pH = 8.0 and this is achieved by adding NaOH until the desired pH is reached.

b) After demineralizing your tissues with the EDTA solution, you need to dehydrate the samples before embedding in paraffin (a wax). Starting from a stock of 90% ethanol solution, you need to make 500mL of 50% ethanol solution and 500mL of 70% ethanol solution to remove excess water. How much stock ethanol solution do you need and how much water do you need to make these solutions?

c) After successfully sectioning your tissue samples you are ready to begin immunohistochemistry to localize smooth muscle and nerve cells. To do this, you need to create the following solutions:

- Tris-EDTA Buffer (10mM Tris, 1mM EDTA, 0.05% Tween 20)
- Methanol Peroxide Solution (80% Methanol, 0.6% Hydrogen Peroxide)
- 5% goat serum in 2.5% w/v Bovine serum albumin (BSA) blocking solution

You have access to the following reagents in the stock room:

- $\mathrm{EDTA \cdot Na_2 \cdot 2\,H_2O}$ (powder, $MW = 372.24$)
- Tris (powder, $MW = 121.14$)
- Tween 20 (liquid)
- 3% Hydrogen Peroxide (liquid)
- 100% Methanol (liquid)
- Dry BSA (powder)
- 100% goat serum (liquid)

You want to make 1 L of the Tris-EDTA buffer, 50 mL of the methanol peroxide solution, and 25 mL of the goat serum in BSA blocking solution. Write out how much of each reagent and water you will need to make these solutions.

The following problems are written by Professor Mcleod or Head TA Miah Turke. They may mimic homework problems closely, but will be highly beneficial for the midterms and final.

***Problem* 6:**

a) Write the equation for $\mathrm{CaCl_2\,(s)}$ dissolving in water.

b) Draw a molecular-level picture of a solution made from dissolved $\mathrm{CaCl_2}$ in water. In the lower box, please draw the solution portion, and in the upper box, draw what it would look like above the solution. For simplicity's sake, plase only draw the ions from two molecules

of $CaCl_2$ and be sure to include enough water molecules in solution to give $CaCl_2$ a mole fraction of 1/6, and include at least 2 additional waters in the gas phase. Use dashed lines to indicate intermolecular interactions.

c) Explain on a molecular level what happens to the vapor pressure of water when you add $CaCl_2$.

***Problem* 7:** You discover an unlabeled organic compound (made of only C and H) in lab and decide to use freezing point depression to determine its molecular weight. You dissolve 6.45 g of the unknown in 523.6 mL of benzene. The freezing point of the solution is now 5.02°C. What is the molecular weight of the compound?

Bonus: Can you guess what this compound might be?