1. You have just finished fermenting a wine and the pH = 3.7. You need 2 mg/L "molecular" SO_2 to protect the wine. What level of free SO_2 do you have to add to achieve the level of the molecular form desired? You can ignore the sulfite (SO_3) form at this pH as the levels will be negligible. Perform by calculation, not by chart or graph, and give answer in mg/L. (25 pts)

SO_2 (molecular form) $<==>$ HSO_3^- + H_3O^+ pKa = 1.89
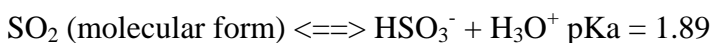
Note: Some of you may notice a possible discrepancy in this pKa value vs. that listed in the lesson. It is worth noting that the dissociation pKa values vary somewhat depending on the alcohol content and binding compounds (acetaldehyde, sugars, etc.) present in the wine vs. often listed aqueous pKa values (1.76 - 1.77). In lesson 7, p12, I indicated a pKa value in wine as 1.81 (vs. 1.89 in the exam and a range of values from other sources). You are welcome to use either value, just note that pKa values are variable depending on the composition of complex solutions. The pKa value you choose does make a big difference in the result.

2. Which of these pairs would make a good buffer solution? Show work! (5 pts)

a. Salt of a strong acid / strong acid

b. Salt of a strong acid / weak acid

c. Salt of a weak acid / weak acid

d. Salt of a strong base / weak base

3. A wine was analyzed for SO_2 content and found to contain 0.76 x 10^{-2} g SO_2/100.00 mL. What is the concentration of the SO_2 expressed in ppm? What are your units for ppm? What would you do if expressing the concentration on a w/w basis? (5 pts)

4. The concentration unit "normality" means "moles of equivalent solute per liter of solvent." (5 pts)

a. True

b. False

5. What is the pH of a solution of 0.0004 M NaOH? Show work! (5 pts)

a. 3.39

b. 4.00

c. 10.6

6. Grape and wine acids are weak organic acids. Explain where on a typical titration curve (titration of a weak acid with a strong base) the buffer capacity is greatest and what buffer capacity means to winemaking. (10 pts)