

## Pre-Lab Homework Assignment

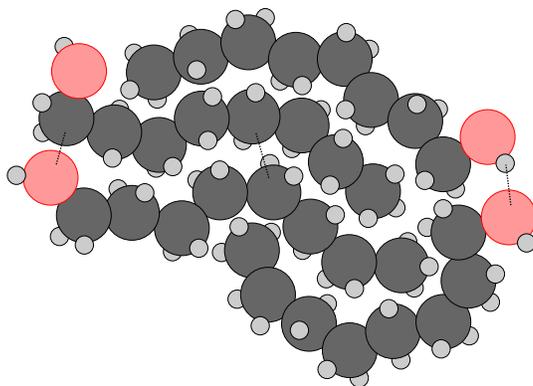
Complete the following homework set and write a lab procedure to be approved by your instructor prior to performing the lab. When writing your procedure, be mindful of the chemicals, quantities and equipment that will be available to you on lab day. Along with your procedure, you will turn in any graphs or figures you were asked to create in this homework set and the answers to the questions on a separate piece of paper, if needed.

1. A student investigates the distribution of an iodine solution between water and cyclohexane. They start with a solution of iodine water, which they titrate with  $\text{Na}_2\text{S}_2\text{O}_3$ , using starch as the end-point indicator, to determine the initial concentration. Then they extract the iodine water with an equal volume of hexane and observe that during the extraction, the cyclohexane layer turns purple. Next, they titrate the post-extraction aqueous layer with  $\text{Na}_2\text{S}_2\text{O}_3$ , again using starch as the end-point indicator. The table below contains the data they collected during their experiment, use this data to determine the distribution ratio of iodine between water and cyclohexane.

	Pre-extraction		Post-extraction	
	Trial 1	Trial 2	Trial 1	Trial 2
Volume of aqueous sample (mL)	10.00	10.00	10.00	10.00
$\text{Na}_2\text{S}_2\text{O}_3$ (M) concentration	0.102	0.102	0.102	0.102
Initial buret reading (mL)	4.75	24.60	6.30	13.60
Final buret reading (mL)	24.60	44.50	13.60	20.70

2. The distribution ratio of  $\text{I}_2$  between water and cyclohexane can be shifted in favor of the aqueous layer by the addition of KI. Draw a diagram showing the organic and aqueous layers as well as all equilibria that involve  $\text{I}_2$ .

3. Assuming that an acetic acid solution is 12% by mass and that the density of the solution is 1.00 g/mL, what volume of 1 M NaOH is needed to fully neutralize a 10 mL aliquot of the acetic acid solution?
4. Acetic acid is a weak acid and sodium hydroxide is a strong base, would you expect the equivalence point for this titration to be above pH 7, at pH 7, or below pH 7? Explain why this is the case.
5. Figure 3 shows the intermolecular forces present in 1-octanol. Identify and label these forces.



**Figure 3.**

6. Sketch a diagram showing the intermolecular forces between acetic acid and water.
7. Sketch a diagram showing the intermolecular forces between acetic acid and 1-octanol.
8. Would you expect acetic acid to be more soluble in water or 1-octanol? Explain your answer.
9. Water and 1-octanol are both able to hydrogen bond, however the two are immiscible. Comment on why you think this is.

10. At the phase boundary between the water and the 1-octanol layers, acetic acid molecules will be constantly crossing back and forth. Write an equilibrium equation for this process.
11. Look up the densities of water and 1-octanol. Which do you expect to be the top layer and which the lower?
12. Write a detailed lab procedure for determining the distribution ratio of acetic acid between water and 1-octanol.