Question 1. *Titration of Propanoic Acid*

What is the pH of 0.100 M solution of propanoic acid (CH3CH2COOH)? (It has a pKa of 4.87 at 25°C).

What is the pH after adding 5 mL of 0.1 M KOH solution to 50 mL of 0.100 M solution of propanoic acid?

What is the pH after adding 25 mL of 0.1 M KOH solution to 50 mL of 0.100 M solution of propanoic acid?

Solution 1.

Question 2. *Which is a strong acid?*
Which of these two is a strong acid?

1. HF
2. HCl

Solution 2.

Question 3. *Calculate the pH of a KOH solution*

A solution, 57.2 mL total volume, contains 0.345 g KOH dissolved in water. Calculate the pH. Classify the solution as acidic, alkaline, or neutral. The water dissociation constant, Kw, has the value 1.0 x 10-14.

Solution 3.

Question 4. *pH of a Hydroiodic Acid Solution*
The value of K_a for hydroiodic acid (HI(aq)) is $3 \cdot 10^9$. Calculate the pH and the pOH of 0.03091 M HI(aq) in water.

Solution 4.

Question 5. *Amino Acid Basics*

(a) How many different kinds of amino acids are found in eukaryotic (membrane-enclosed cells) species such as humans?

9 21 24 26

(b) How many amino acids found in humans are "essential," or obtained only through dietary sources?

9 21 24 26

(c) The amino acids involved for human biology are usually divided into which 4 broad groups? Check all that apply.

Electrically charged side chains Chiral side chains Electrically uncharged yet polar side chains Hydrophobic side chains Sulfide-containing side chains Ring-containing side chains Special cases

Solution 5.

Question 6. *Self Assembly of Sodium Dodecyl Sulfate*

Sodium dodecyl sulfate (SDS) has the structure CH3(CH2)11OSO3Na. Assume each carbon-carbon bond in the non-polar chain is 150pm long. Assume the exposed area of the hydrophilic head is defined by a circle of radius equal to the length of an S-O bond, which is around 140pm. In this solvent, the tail contracts to a volume of $0.025nm^3$

Under these conditions, does SDS form a micelle, cylinder, or bilayer?

1. Micelle
2. Cylinder
3. Bilayer

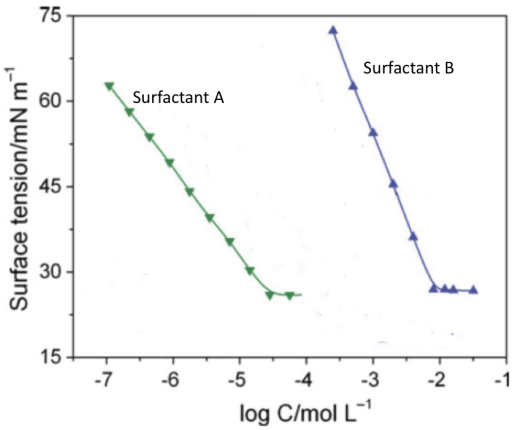
Two more non-polar chains are bound to SDS to change the properties of the surfactant. Assume each additional non-polar chain adds another 0.025nm3 to the volume occupied by the chains in solution. Also, assume all chains are attached at the head, so the stretched out length of the molecule does not change.

Under these conditions, does the new SDS derivative form a micelle, cylinder, or bilayer?

Micelle Cylinder Bilayer

Solution 6.

Question 7. *Surfactant Comparisons*
The surface tension versus log concentration for two surfactants is shown below.



(a) Which of the following statements about micelle formation is TRUE:

1. The critical micelle concentration of Surfactant A is higher than that of Surfactant B.
2. The critical micelle concentration of Surfactant A is lower than that of Surfactant B.
3. The critical micelle concentration of Surfactant A is the same as Surfactant B.
4. There is no evidence for micelle formation in the above plot.

(b) Which of the following statements about the surfactants is MOST LIKELY:

Surfactants A and B are both nonionic.

Surfactant A is ionic and Surfactant B is nonionic.

Surfactant A is nonionic and Surfactant B is ionic.

Surfactants A and B are both ionic.

Solution 7.