

## Detergents

[14 pts] Read the article, "Detergents," from pp. 4-7 of the April 1985 issue of *ChemMatters*, and answer the following questions.

- [1 pt] What is the difference between soap and detergent?  
Soap is made from animal fat or vegetable oil while detergents are made from petroleum and industrial chemicals.
- [1 pt] What are the three key ingredients in the formulation of a detergent?  
Surfactants, builders, & fillers
- [2 pts] What are the three classifications of surfactants? Describe the distinguishing characteristics of each.  
Anionics: their active component is an anion  
Cationics: their active component is a cation  
Nonionics: they contain no ions
- [1 pt] What two points of similarity are there between soaps and detergents, as shown in Fig. 1a?  
Both have long, nonpolar hydrocarbon chains that are soluble in fats and oils and a charged, water-soluble portion.
- [1 pt] How do soaps and surfactants dissolve both oil and water (Fig. 1b)?  
They dissolve their polar end in the water and their nonpolar end in the oil.
- [2 pts] How do nonionics dissolve in water? Why are they used only for lighter cleaning chores?  
They rely on the presence of many polar oxygen atoms in their structure to make them soluble in water. They do not produce heavy suds and are not as effective after heavy doses of fat and grease.

7. [1 pt] Why are detergents better than soaps in “hard” water?  
The synthetic surfactants used in detergents are less likely to form scum in the presence of calcium and magnesium ions.
8. [1 pt] What are the two roles of phosphate builders?  
They raise the pH of the wash solution because alkalinity helps cut through fats and grease by saponification others are sequestering agents that can attach to  $Mg^{2+}$  and  $Ca^{2+}$  so that these ions cannot combine with the surfactants.
9. [2 pts] What two roles does “CMC” play in the cleaning process? How does sodium sulfate help the process?  
CMC is used to thicken liquid laundry and dishwashing formulations and also acts as an antiredeposition reagent to prevent dirt from settling back on the fabric or dishes. Sodium Sulfate adds bulk to the detergent and helps prevent powdered detergent from caking.
10. [2 pts] How did ABS cause the “mystery foam” and how was the problem solved?  
ABS was immune to breakdown by natural bacteria that normally decomposed soap molecules (because of its branches). It was replaced by DDBS, which has an unbranched hydrocarbon chain.