

Supporting information

Teaching and assessing systems thinking in first-year chemistry

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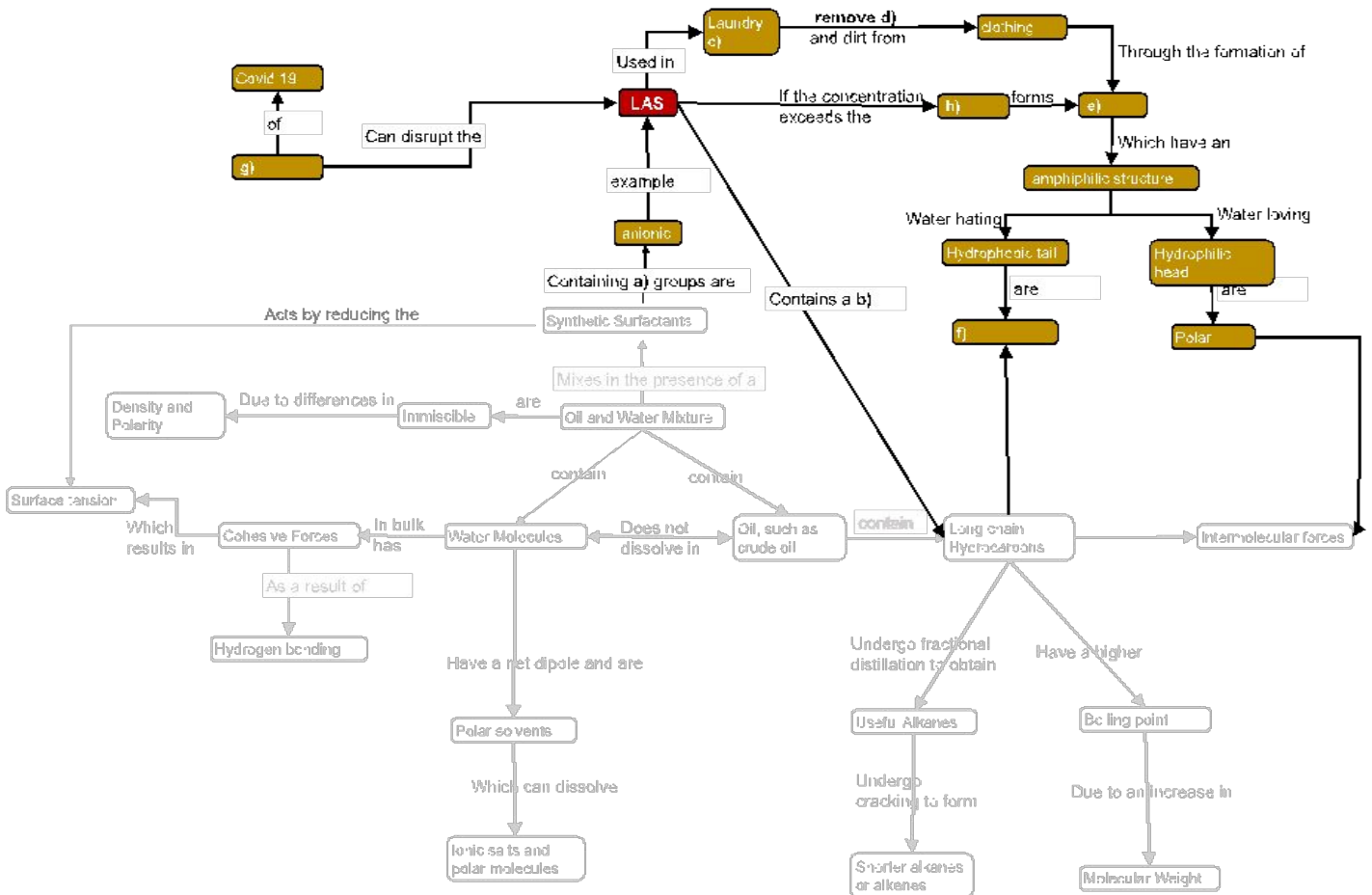
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Practical Activity 1

Societal Subsystem

Description

In this practical activity, you will collaborate with your group members to answer the questions about the societal subsystem as in the expanded concept map.



Expanded Concept Map: Societal Subsystem

Instructions

In your economic subsystem group, work together to answer the following questions. The group presenter must share their screens and submit the activity answers on behalf of the group.

Total questions

9

Total points

20

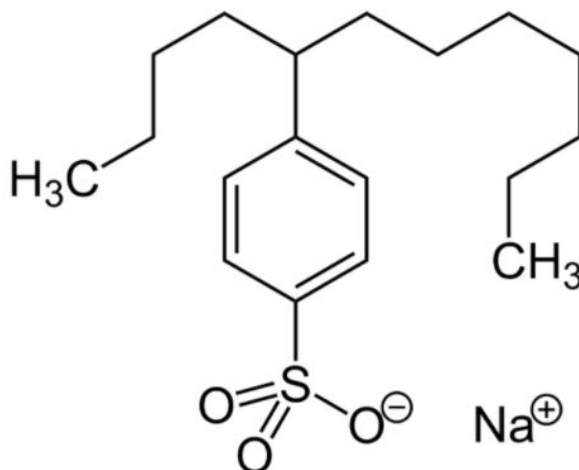
Question 1 (Matching- 5 marks)

Identify the chemical names associated with certain chemical characteristics of concepts relating to the social subsystem of linear alkylbenzene sulfonate by matching the concepts (**choose from the following concepts Dodecane, Detergent, Micelle, Oil and Sulfonate**)

| Question | Answer |
|--|--------|
| A. the functional group present in synthetic surfactants illustrated by a) on the expanded concept map | |
| B. Long-chain hydrocarbon illustrated by (b) on the expanded concept map | |
| C. Contains surfactants that lower the surface tension illustrated by c) on the expanded concept map | |
| D. Greasy hydrophobic molecules illustrated by d) on the concept map | |
| E. Is an aggregate with an amphiphilic structure illustrated by e) on the expanded concept map | |

Question 2 (Jumbled sentence- 8 marks)

The structure of LAS is provided below.



Explain the difference in polarity and solubility of the different groups in the surfactant molecule by choosing the correct answer for the blank from the drop-down list provided.

The 12-carbon alkyl chain of linear alkylbenzene sulfonate is **[a]** (refer to f) on the expanded concept map), since a long chain hydrocarbon is symmetrical and has **[b]** spread electrons. Its polarity will allow it to be more soluble in **[c]**. The benzene group has six carbon-hydrogen covalent bonds that are equally spaced, and since benzene is a perfect hexagon with angles of 120° , it is also a symmetrical molecule and is therefore **[d]**, which will allow it to be more soluble in **[e]**. The sulfonate group has a negative charge on the oxygen atom and since it is anionic, the electrons in this

functional group are [f] spread and it is, therefore [g] making it more soluble in [h]. As a whole linear alkylbenzene sulfonate, therefore, has a hydrophilic and a hydrophobic part.

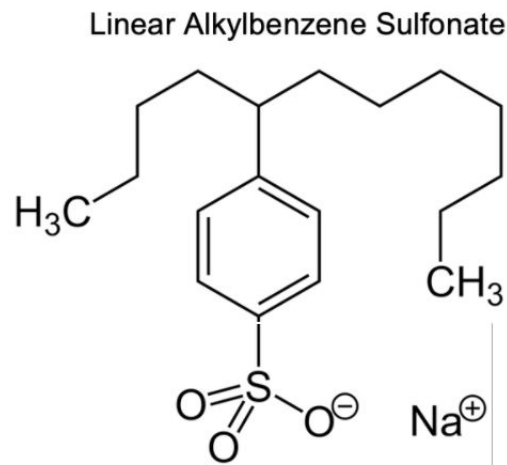
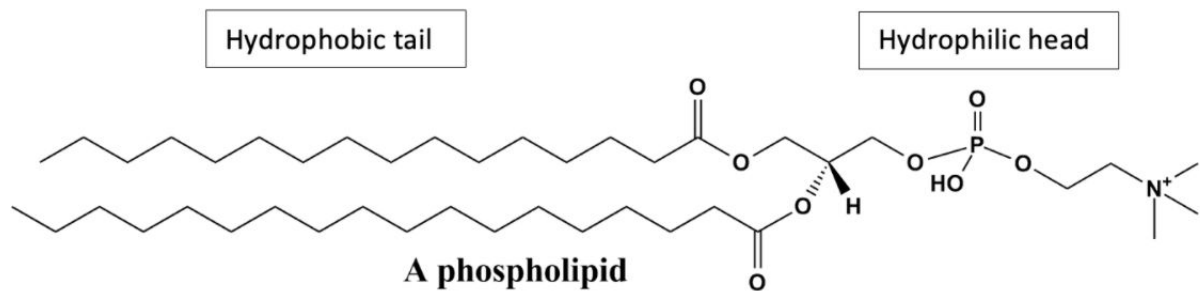
Drop-down List of Answers

polar
non-polar
evenly
unevenly
water
oil

Question 3 (Hotspot- 1 mark)

During the covid-19 pandemic, linear alkylbenzene sulfonate has contributed greatly to keeping cloth face masks and clothing covid-19 free by breaking the (g) on the expanded concept map of the virus. The image below shows a structure of the phospholipids that make up the envelope of a virus.

Click on the part of the Linear alkylbenzene molecule that will disrupt the hydrophilic head of the phospholipids.



Question 4.1 (Fill in the blank- 1 mark)

Identify the variable shown as a concept on the expanded concept map that can determine whether surfactants will be effective or not and fill in the blank.

For LAS in laundry detergents to work effectively, the concentration added must exceed the [a] to encourage micelle formation to ensure dirt and oil are removed from clothing

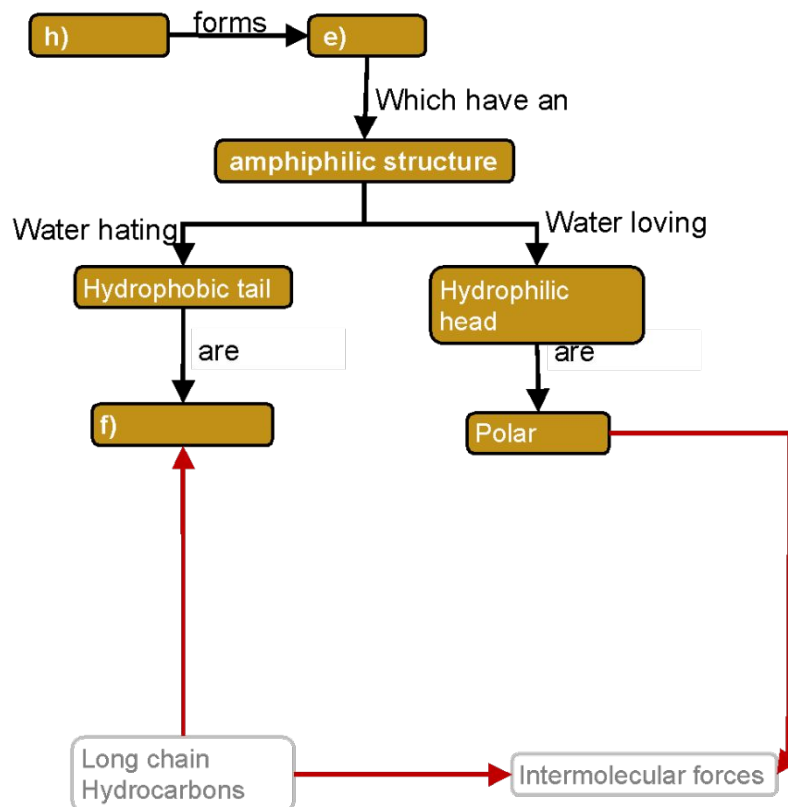
Question 4.2 (True/False- 1 mark)

To explain how surfactants behave to remove oil and dirt from clothing, say whether the following statement is true or false:

If a micelle entraps oil or dirt, the polar tail will be attracted to the non-polar oil or dirt particles, and the non-polar head would be attracted to the polar water. Hence, trapping the oil or dirt, allowing it to mix so that it can be washed away.

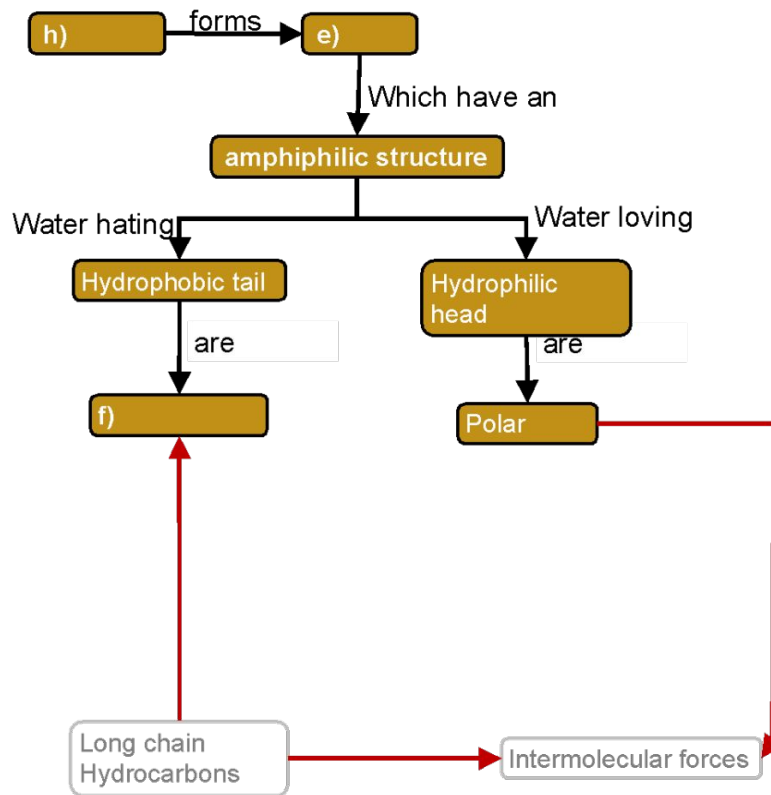
Question 5.1 (Hotspot- 1 mark)

Click on the red arrow on which you would place the following linking words:
"have no net dipole and are thus"



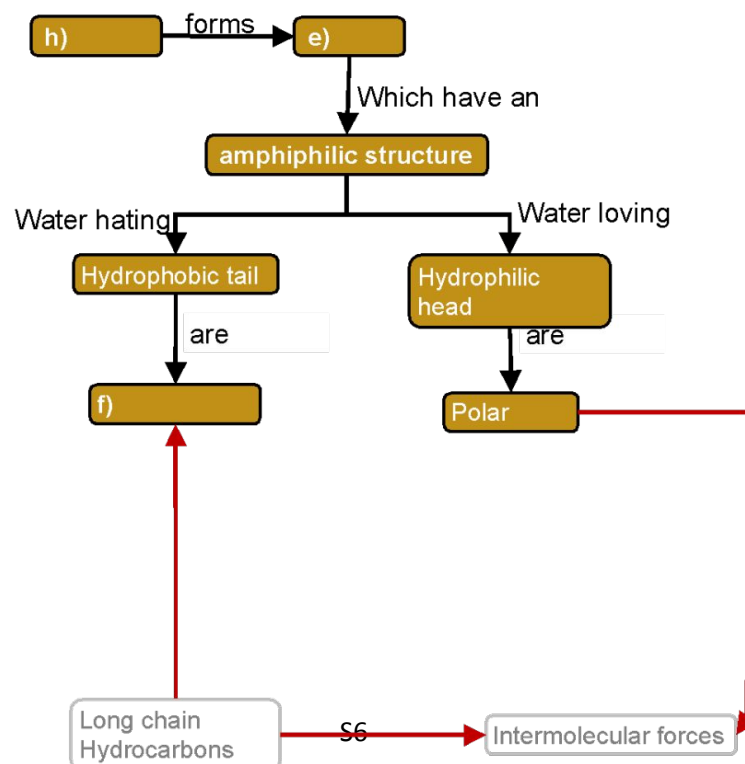
Question 5.2 (Hotspot- 1 mark)

Click on the red arrow on which you would place the following linking words:
"With dipole-dipole"



Question 5.3 (Hotspot- 1 mark)

Click on the red arrow on which you would place the following linking words:
"With weak London dispersion"



Question 6

(Jumbled

question, enrichment- 0 marks)

Discuss in your group whether these concepts belong to the social, economic, or environmental subsystem and fill in the blank.

- Drinking water can potentially fit within the **[a]** subsystem
- Wastewater Treatment Plants can potentially fit within the **[b]** subsystem
- Sewage can potentially fit within the **[c]** subsystem
- Rural villages can potentially fit within the **[d]** subsystem
- Food can potentially fit within the **[e]** subsystem
- Cytotoxic can potentially fit within the **[f]** subsystem
- Household can potentially fit within the **[g]** subsystem
- Chemical waste can potentially fit within the **[h]** subsystem
- Health risks can potentially fit within the **[i]** subsystem
- Population can potentially fit within the **[j]** subsystem

For further enrichment discuss the following in your subsystem group:

1. How you would link these concepts to other concepts in the societal subsystem?
2. What would your linking words be on the arrows when you connect two or three concepts in the societal subsystem?