Orienting a Detergent Molecule in Water

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A class models a detergent molecule as a charged head attached to a long nonpolar tail. The class uses a simplified model in which the head interacts favorably with water and the tail can associate with a nonpolar oil droplet. Neither liquid reacts chemically in the model.

Trial	Contents after mixing	Observation after a short wait
1	Water and oil	One oil layer forms again
2	Water, oil, and detergent	Many small oil droplets remain dispersed

1 Which orientation fits the model at the surface of a droplet in trial 2?

(1) The heads point into oil and tails point into water.

(2) The heads point into water and tails associate with oil.

(3) The heads and tails both point into the oil only.

(4) The heads and tails both avoid the oil.

2 Use the model to explain why a molecule with both parts can stay at the boundary between the oil and water. [1]

Answer and work

A student says the oil must have reacted because trial 2 no longer shows a separate oil layer. The class takes a small sample and still sees tiny oil droplets.

3 Use the droplet observation to explain why the missing layer is consistent with a physical change. [1]

Answer and work

4 A model molecule keeps the same charged head but its tail is replaced by a part that strongly favors water over oil. Explain why it may be less useful at the droplet surface. [1]

Answer and work