Tracking a Hidden Water Layer in a Cup

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

A museum cup model holds two sealed water compartments separated by a thin wall. Water cannot cross the wall, but heat can. The outer compartment contains 100 g of water at 20 °C. A warm inner compartment contains 100 g of water at 40 °C. No energy goes to the surroundings, and the two water portions have the same specific heat. The walls and cup store negligible energy.

1 Which process can happen through the separating wall?

(1) Heat transfers from the inner water to the outer water.

(2) Heat transfers from the outer water to the inner water until both reach 20 °C.

(3) Water moves from the inner compartment into the outer compartment.

(4) Both portions lose thermal energy at the same time.

2 Predict the common final temperature if the cup contains only the two compartments described. Use the equal water masses in your reasoning. [1]

Answer and work

The display adds a sealed pocket of 100 g of water at 20 °C behind the outer compartment. All three portions can exchange heat. The water masses, starting temperatures, and negligible losses for the original two portions are unchanged.

3 Calculate the common final temperature in the three-compartment model. Show how the hidden water changes the energy balance. [1]

Answer and work

4 A student sees the lower final temperature and concludes that heat escaped from the cup. Explain how the hidden pocket offers another explanation. [1]

Answer and work