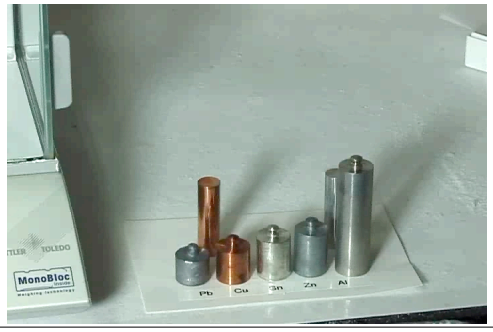
Specific Heat of Al - DCI 3.2



Data from BCE 3.2

Data: mass of aluminum = 57.968g
mass of water = 213.932 g
Initial temperature of the water in the calorimeter is 27.73 C
Final temperature of the water in the calorimeter is 31.53 C
Initial temperature of the aluminum is 100.0 C
The calculated specific heat for aluminum using these numbers will be 0.857 joules/g^{-1} C^{-1}
What is the literature value for the specific heat of aluminum (0.90j/gK).

What is the calculated value of the specific heat of aluminum from BCE 3.2?

DCI 3.2

In your group compare the calculated specific heat of aluminum you obtained in your BCE.
Discuss any difference in the calculated value and come to a consensus value for the specific heat of aluminum
What is the literature value for the specific heat of aluminum.
Is there any difference between your experimental specific heat of aluminum and the literature value?
If the experimental and literature values do not agree suggest possible reasons.
Describe how the heat flows between the Al and the water in the calorimeter

Problem

Which of the following are plausible explanations for the measured value of the specific heat of Al being lower than the actual value found in the literature?

1. BP of water is less than 100°C (at the location the experiment was performed)
2. BP of water is greater than 100°C (at the location the experiment was performed)
3. Heat is lost from aluminum to air during the transfer.
4. Water evaporated so the mass is actually less than measured.
5. Heat from the aluminum is gained by the thermometer and the coffee-cup calorimeter as well as the water.

BP of water is less than 100°C
(BP of water is greater than 100°C)

$$m_{Al}\, C_{Al}\, \Delta t_{Al} = m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}$$

$$C_{Al} = \frac{m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}}{m_{Al}\, \Delta t_{Al}}$$

C_{Al} at 100°C < C_{Al} at 90°C

Actual t @ 90°C, C_{Al} has a larger value than we are calculating

Heat is lost from aluminum to air during the transfer.

$$m_{Al}\, C_{Al}\, \Delta t_{Al} = m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}$$

$$C_{Al} = \frac{m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}}{m_{Al}\, \Delta t_{Al}}$$

C_{Al} heat lost < C_{Al} heat not lost

Actual heat lost, C_{Al} has a smaller value than when we assume no heat is lost

Water in the calorimeter evaporated so the mass is actually less than measured.

$$m_{Al}\, C_{Al}\, \Delta t_{Al} = m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}$$

$$C_{Al} = \frac{m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}}{m_{Al}\, \Delta t_{Al}}$$

C_{Al} water less < C_{Al} water constant

Heat from the aluminum is gained by the thermometer and the coffee-cup calorimeter as well as the water.

$$m_{Al}\, C_{Al}\, \Delta t_{Al} = m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}$$

$$C_{Al} = \frac{m_{H_2O}\, C_{H_2O}\, \Delta t_{H_2O}}{m_{Al}\, \Delta t_{Al}}$$

C_{Al} 90% heat transferred < C_{Al} 100% heat transferred

Actual transfer @ 90%, C_{Al} has a smaller value than we are calculating

Problem

Assuming that heat is directly transferred between water and Al, which of the following statement(s) is (are) true?

1. Heat flows from the Al to the water
2. Cold flows from the water to the Al
3. The heat absorbed by the water is equal to the heat released by the Al
4. The heat absorbed by the water is greater than the heat released by the Al
5. The heat absorbed by the water is less than the heat released by the Al

Problem

If the amount of aluminum in the experiment is halved, which of the following statement(s) is (are) true?

1. More heat would be released by the aluminum
2. Less heat would be absorbed by the water
3. The value of the specific heat of aluminum would be smaller.
4. The initial temperature of the Al would be smaller
5. The final temperature of the water would be smaller

Problem

If the amount of water in the calorimeter is doubled, which of the following statement(s) is (are) true?

1. More heat would be released by the aluminum
2. Less heat would be absorbed by the water
3. The value of the specific heat of aluminum would be smaller.
4. The final temperature of the Al would be smaller
5. The final temperature of the water would be smaller

3.3a. Describe how heat is transferred in physical and chemical processes [Readings 5.4]

Heat Flow

- Chemical and physical processes can lose or absorb heat.
- When a chemical or physical system loses heat to the environment - exothermic process (negative sign -q).
- When a chemical or physical system absorbs heat from the environment - endothermic process (positive sign +q).
- Heat spontaneously flows from high temperature to low temperature.