

# Take-Home Assignment 02 Key

One experimental method for identifying a metal is to heat a known mass of the metal to a high temperature, transfer the sample to a calorimeter that contains a known mass of water at room temperature, and measure the final temperature of the water and the metal after thermal equilibrium is reached. Here is some data from a typical experiment:

- mass of water: 45.059 g
- mass of metal: 20.031 g
- room temperature: 24.36 °C
- initial temperature of metal: 93.61 °C
- final temperature: 27.59 °C

The identification number for your sample is 51m and it is one of the metals in the table below.

metal	S (J/g°C)
AlBe Alloy	1.507
aluminum	0.921
silicon	0.712
scandium	0.586
iron	0.461
zinc	0.377
molybdenum	0.227

What is the identify of your metal? Place your work in the space below and turn in this take-home assignment at the beginning of our next class.

## Solution

The heat lost by the metal is equal to the heat gained by the water; thus

$$\begin{aligned} -q_{\text{water}} &= q_{\text{metal}} \\ -m_{\text{water}} \times S_{\text{water}} \times \Delta T_{\text{water}} &= m_{\text{metal}} \times S_{\text{metal}} \times \Delta T_{\text{metal}} \end{aligned}$$

Substituting in known values

$$-45.059 \text{ g} \times 4.184 \text{ J/g}^\circ\text{C} \times (24.36 - 27.59)^\circ\text{C} = 20.031 \text{ g} \times S_{\text{metal}} \times (93.61 - 27.59)^\circ\text{C}$$

Solving gives  $S_{\text{metal}}$  as 0.461 J/g°C, which corresponds to Fe.