

Calorimetry problems—for dry lab day

INSTRUCTIONS: answer the following questions on binder paper. Please show all your work, with correct units. (yes, the answers are there, but I am looking at setups. The answers are there for you to check your work.). Your work should be logically presented and easy to follow. You will be graded on significant figures, units, and the quality of your work.

$\Delta H_{\text{fus}} = 6.01 \text{ kJ/mol}$ or 333 J/g , $\Delta H_{\text{vap}} = 40.67 \text{ kJ/mol}$ or 2257 J/g ; Specific heat of water = $4.184 \text{ J/g}^\circ\text{C}$.

1. A bag of ice was placed on a patient's head. The ice bag contained 220.0g of ice at 0.00°C . When the ice bag was removed, all of the ice inside had melted and the liquid had a temperature of 21.00°C . How many joules of heat were added? [92.6 kJ]
2. Determine the specific heat of Cu from the fact that 64.0J are needed to raise the temperature of 15.0 g of Cu metal from 22.0°C to 33.0°C . [0.388 J/g $^\circ\text{C}$]
3. How many joules are required to convert 10.0g of solid ethyl alcohol at -180.3°C to the vapor state at the boiling point of 78.3°C ?
 - a. $C_{[\text{solid EtOH}]} = 0.971 \text{ J/g}^\circ\text{C}$
 - b. $C_{[\text{liquid EtOH}]} = 2.30 \text{ J/g}^\circ\text{C}$
 - c. The melting point of alcohol is -117.3°C
 - d. $\Delta H_{\text{fus}} = 218 \text{ J/g}$
 - e. $\Delta H_{\text{vap}} = 854 \text{ J/g}$.} [15.8 kJ]
4. A 50.0-g sample of water at 100.00°C was placed in an insulated cup. Then 25.3-g of zinc at 25.00°C was added to the water. The temperature of the water dropped to 96.68°C . What is the specific heat of the zinc?[0.383 J/g $^\circ\text{C}$]
5. An insulated cup contains 75.0g of water at 24.00°C . A 26.00g sample of metal at 82.25°C is added. The final temperature of the water and metal is 28.34°C . What is the specific heat of the metal? (ans 0.971 J/g $^\circ\text{C}$)
6. A calorimeter has a heat capacity of 1265 J/ $^\circ\text{C}$. A reaction causes the temperature of the calorimeter to change from 22.34°C to 25.12°C . How many joules of heat were released in this process? (ans. 3.52 kJ released)
7. What is the specific heat of silicon if it takes 192J to raise the temperature of 45.0g of Si by 6.0°C ? (ans. 0.71 J/g $^\circ\text{C}$)
8. A 70.0 g sample of water at 95.00°C is mixed with 50.0 g of water at 135.0°C . Calculate the final temperature of the mixture assuming no heat loss to the surroundings. Remember that the heat gained by the cooler water is equal to the heat lost by the warmer water.
9. Camphor ($\text{C}_{10}\text{H}_{16}\text{O}$) has energy of combustion of -5903.6 kJ/mol . When a sample of camphor with mass 0.1204 g is burned in a calorimeter, the

temperature increases by 2.28°C . Calculate the heat capacity of the calorimeter. [$2.06\text{kJ}/^{\circ}\text{C}$]