186

Mini-Lab: Boiling Substances - Part II

In part I you created a heating curve to apply Module 1 content. We will now apply Module 2 content to the information from this lab.

Number your responses to the following on the right hand page. Show all set up and work for calculations

1. When a substance reaches its boiling point, added heat will no longer raise the temperature of the liquid. Based on this, what is the boiling point of each substance according to ***your*** data?
2. The accepted boiling points of ethanol and water are 78.37°C and 100.00°C respectively. Choose one and calculate your percent error (show all work!)
3. The specific heat (c) of water is 4.184 J/g°C. Use $q = mc\Delta T$ to determine how much energy (q) was required to bring your water from room temperature to its boiling point (for mass (m), remember that the density of water is 1.00g/mL)

Challenge! Determine the specific heat of ethanol (optional)

A • Divide your answer from #4 by the time required for the water to reach its boiling point. This is the energy output of your specific hotplate during the experiment in J/s. Multiply this number by the time required to boil ethanol to find the heat absorbed by the ethanol during that time (q)

B • The density of ethanol is 0.789g/mL. Use this information to find the mass of 35.0 mL of ethanol

C • Use $q = mc\Delta T$ to solve for the specific heat (c) of ethanol

(A) 11300 J / 600. s = 18.8 J/s

$\frac{270\,s \mid 18.8\,J}{s} = $ **5080 J** ← energy to boil ethanol (q)

(B) $\frac{35.0\,mL \mid 0.789\,g}{mL} = 27.6\,g$ ← mass of ethanol

(C) $c = \frac{q}{m\Delta T}$ ← rearrange first!

$c = \frac{5080\,J}{(27.6\,g)(79°C - 22°C)} = $ **3.23 J/g°C** ← accepted is 2.46 J/g°C, so we had a pretty large % error (31%)

(1) will vary depending on class period & group

(2) $\%Error = \frac{|accepted - experimental|}{accepted} \times 100$

example (posted data):

$BP_{Ethanol} = 79.4°C$

$\frac{|78.37°C - 79.4°C|}{78.37°C} \times 100 = $ **1.31%**

(3) Known: $m = 35.0\,g$

$c = 4.184\,J/g°C$

$\Delta T = |99.2°C - 22.0°C|$

$= 77.2°C$

$q = (35.0\,g)\left(\frac{4.184\,J}{g°C}\right)(77.2°C)$

q = 11300 J