

NAME_____ **SAMPLE!!**

HEAT LAB 05:

PART ONE

PREDICT THE TEMPERATURE!!

Take an amount of Hot Water and half the amount of Cold Water.

Predict what you think the final temperature will be!

Mix Them!

OBJECT	MASS	StartingTemp	Final Temp	SpecificHeat
Hot Water	<i>.213 kg</i>	<i>78 °C</i>	<i>55</i>	4187 J/kg/°C
Cold Water	<i>.098 kg</i>	<i>17 °C</i>	<i>55</i>	4187 J/kg/°C

How much heat did the Hot Water lose?

$$\Delta Q = mC\Delta T =$$

$$.213\text{kg} * (4187) * (78 - 55) =$$

$$.213\text{kg} * 4187 * (23^\circ) = 20,512 \text{ Joules}$$

How much heat did the Cold Water gain?

$$\Delta Q = mC\Delta T =$$

$$.098 * 4187 * (55 - 17) =$$

$$.098 * 4187 * (38^\circ) = 15,592 \text{ Joules}$$

Are these the same? Should they be? What should've the final temperature been? What is your percent error? Why? Explain what happened in terms of the molecules and heat transfer.

We lost 20,512 - 15,592 Joules of Heat = 4920 Joules of heat lost to air

The final temperature for this should have been 58.78°C

$$mC\Delta T = mC\Delta T$$

$$.213 (4187)(78 - T_f) = .098 (4187) (T_f - 17)$$

$$891.831 (78 - T_f) = 410.326 (T_f - 17)$$

$$69562.8 - 891.8 T_f = 410.3 T_f - 6975.5$$

$$76538.3 = 1302.1 T_f$$

$$T_f = 76538.3 / 1302.1 = 58.78 \text{ °C}$$

$$\text{Percent Error} = |\text{Theor} - \text{Actual}| / \text{Theor} =$$

$$(58.78 - 55) / 58.75 = 3.78 / 58.78 = 6.43 \% \text{ error}$$

PART TWO:

Determine the specific heat of aluminum!

Place an amount of HOT water in an aluminum calorimeter, along with an amount of an ice cube. When the ice melts, determine the final temperature and the specific heat of the calorimeter.

OBJECT	MASS	START TEMP	FINAL TEMP	SPECIFIC HEAT	Heat of Fusion
Al Cup	<i>.016 kg</i>	<i>23°C</i>	<i>46°C</i>	??	XXXXX
Water	<i>.110 kg</i>	<i>75 ° C</i>	<i>46°C</i>	4187 J/kg/°C	XXXX
ICE	<i>.022 kg</i>	<i>0 °C</i>	<i>46°C</i>	2090 J/kg/°C	335,000 J/kg

How much energy did the hot water lose?

$$\begin{aligned} \text{The hot water lost } \Delta Q &= mC\Delta T = .110 * 4187*(75-46) \\ &= .110*4187*29= \\ &= 13356 \text{ Joules} \end{aligned}$$

How much energy did the ice gain by melting?

$$\begin{aligned} \text{By melting (solid to liquid)} &= m H_f = .022 * 335,000= \\ &= 7370 \text{ Joules} \end{aligned}$$

How much energy did the ice gain by heating up (as water)?

$$\begin{aligned} \text{As Ice Water it gained } \Delta Q &= mC\Delta T = .022 * 4187*(46-0) \\ &= .022*4187*46= \\ &= 4237.244 \text{ Joules} \end{aligned}$$

How much energy must've the Al cup gained?

$$\begin{aligned} \text{Hot Water Lost} &= \text{Ice Gained (Melting + Heating)} + \text{Al Cup gained} \\ 13356 &= (7370 + 4237.244) + \text{Al Cup gained} \\ \text{Al Cup gained} &= 13356.23 - (7370+4237.244) = 1748.986 \text{ Joules} \end{aligned}$$

What is the specific heat of Al according to your lab?

$$\begin{aligned} \text{It gained } \Delta Q &= mC\Delta T = .016 * C_{Al}*(46-23)= 1748.986 \\ C_{Al} &= 1748.986/ (.016*23) = 4752.679348 \text{ Joules} \end{aligned}$$

How does this compare with the real specific heat?

$$\text{The real specific heat is } 900 \text{ J/kg}^\circ\text{C}$$

What is your percent error?

that gives me a percent error of $(4752.6 - 900) / 900 = 428\%$!!

Why?

Well, I wasn't too far off! There was probably heat loss to the surroundings, and I didn't wait long enough.... The cup only SHOULD have gained $(.016 * 900 * 23) = 331.2$ Joules of heat...I calculated it gained 1748 Joules, so 1415 Joules was lost to the surroundings.

The real final temperature should have been around 48.5 °C

$$.110 * 4187 * (75 - T_f) = .022 * 335,000 + .022 * 4187 * (T_f - 0) + .016 * 900 * (T_f - 23)$$

algebra or math solver shows the real final temp....

Explain what happened in terms of the molecules and heat transfer.