Name: ______________________________ Date __________ Section __________

Lab Partner: ______________________________

Data Sheet 1: Heat of Neutralization of a Strong Acid

Concentrations: Acid __1.185__ M Base __1.327__ M

Direct Observations:	**First Determination** acid	base	**Second Determination** acid	base
1.) Volume, **V**:	100 mL	100 mL	100 mL	100 mL
2.) Temp before mixing, $\mathbf{T_i}$:	22.6 °C		23.4 °C	
3.) Temp after mixing, $\mathbf{T_f}$:	30.0 °C		30.2 °C	
Calculations:				
4.) Number of moles, **n**:	______	______	______	______
5.) Moles neutralized, $\mathbf{n_{neut}}$:	______________		______________	
6.) Total volume, $\mathbf{V_{tot}}$:	______________ mL		______________ mL	
7.) Temp, before mixing, $\mathbf{T_i}$:	______________ K		______________ K	
8.) Temp. after mixing, $\mathbf{T_f}$:	______________ K		______________ K	
9.) Temperature change, Δ**T**:	______________ K		______________ K	
10.) Cp of solution, $\mathbf{C_{p,sol}}$:	______________ J/K		______________ J/K	
11.) Cp of Calorimeter, $\mathbf{C_{p,cal}}$:	50 J/K		50 J/K	
12.) Total heat capacity, $\mathbf{C_{p,tot}}$:	______________ J/K		______________ J/K	
13.) Heat Transfer, **Q**:	______________ J		______________ J	
14.) Heat of Neutralization, $\Delta\mathbf{H_{neut}}$:	______________ kJ/mol		______________ kJ/mol	

15.) Mean ΔH_{neut}: ______________ kJ/mol

16.) Percent error for ΔH_{neut} ______________ %
(*literature value* $\Delta\mathbf{H_{neut}}$= **-57.70kJ/mole**)

Useful Equations:

$$\Delta T = T_f - T_i$$

$$C_p = m \cdot C_s = d \cdot v \cdot C_s$$

$$C_{p,tot} = C_{p1} + C_{p2}$$

$$Q = -C_p \cdot \Delta T$$

$$\Delta H = Q / n$$

$$d_{sol} = 0.988 g / mL$$

$$C_{s,sol} = 4.18 J / g \cdot K$$

$$C_{p,cal} = 50 J / K$$

(Updated 091103 *C. Bolon*)

Name: ______________________________ Date __________ Section _________

Lab Partner: __________________________

Data Sheet 2: Heat of Neutralization of a Weak Acid

Concentrations: Acid __0.998____M Base__1.327__M

Direct Observations:

	First Determination		Second Determination	
	acid	base	acid	base
1.) Volume, **V**:	100 mL	100 mL	100 mL	100 mL
2.) Temp before mixing, $\mathbf{T_i}$:	22.4 °C		22.8 °C	
3.) Temp after mixing, $\mathbf{T_f}$:	29.6 °C		30.4 °C	

Calculations:

	First Determination		Second Determination	
4.) Number of moles, **n**:	______	______	______	______
5.) Moles neutralized, $\mathbf{n_{neut}}$:	____________		____________	
6.) Total volume, $\mathbf{V_{tot}}$:	____________ mL		____________ mL	
7.) Temp, before mixing, $\mathbf{T_i}$:	____________ K		____________ K	
8.) Temp. after mixing, $\mathbf{T_f}$:	____________ K		____________ K	
9.) Temperature change, $\Delta\mathbf{T}$:	____________ K		____________ K	
10.) Cp of solution, $\mathbf{C_{p,sol}}$:	____________ J/K		____________ J/K	
11.) Cp of Calorimeter, $\mathbf{C_{p,cal}}$:	50 J/K		50 J/K	
12.) Total heat capacity, $\mathbf{C_{p,tot}}$:	____________ J/K		____________ J/K	
13.) Heat Transfer, **Q**:	____________ J		____________ J	
14.) Heat of Neutralization, $\Delta\mathbf{H_{neut}}$:	____________ kJ/mol		____________ kJ/mol	

15.) Mean ΔH_{neut}: ____________ kJ/mol

16.) Percent error for ΔH_{neut} ____________ %
(*literature value* $\Delta\mathbf{H_{neut}}$**= -57.70kJ/mole**)

Useful Equations:

$$\Delta T = T_f - T_i$$

$$C_p = m \cdot C_s = d \cdot v \cdot C_s$$

$$C_{p,tot} = C_{p1} + C_{p2}$$

$$Q = -C_p \cdot \Delta T$$

$$\Delta H = Q / n$$

$$d_{sol} = 0.988 g / mL$$

$$C_{s,sol} = 4.18 J / g \cdot K$$

$$C_{p,cal} = 50 J / K$$

(Updated 091103 *C. Bolon*)

Name: ________________________________ Date ___________ Section __________

Lab Partner: ___________________________

Data Sheet 3: Heat of Fusion of Ice

	First Determination		Second Determination	
Direct Observations:				
17.) Mass of cup & water, $\mathbf{m_{cup\text{-}w}}$:	101.204	g	103.189	g
18.) Mass of cup, $\mathbf{m_{cup}}$:	4.265	g	4.345	g
19.) Temp before mixing, $\mathbf{T_i}$:	23.6	°C	22.7	°C
20.) Temp after mixing, $\mathbf{T_f}$:	7.8	°C	8.3	°C
21.) Mass of cup, water, & melted ice, $\mathbf{m_{Tot}}$:	123.962	g	121.765	g
Extrapolated Data and Calculations:				
22.) Mass of water, $\mathbf{m_w}$:		g		g
23.) Mass of ice, $\mathbf{m_{ice}}$:		g		g
24.) Temp of water before mixing, $\mathbf{T_i}$:		K		K
25.) Temp after mixing, $\mathbf{T_f}$:		K		K
26.) ΔT water, $\Delta\mathbf{T_w}$:		K		K
27.) ΔT ice, $\Delta\mathbf{T_{ice}}$:		K		K
28.) Enthalpy change of water, $\Delta\mathbf{H_w}$:		J		J
29.) Enthalpy change of melted ice, $\Delta\mathbf{H_{ice}}$:		J		J
30.) Enthalpy change of calorimeter, $\Delta\mathbf{H_{cal}}$:		J		J
31.) Enthalpy change of melting, $\Delta\mathbf{H_{fus}}$:		J		J
32.) Enthalpy of fusion per gram of ice, $\Delta\mathbf{H_{fus}}$**/g**:		J/g		J/g

33.) Mean ΔH_{fus}/g: ______________ J/g

34.) Percent Error for ΔH_{fus}/g ______________ %
(*literature value* $\Delta\mathbf{H_{fus}}$**/g = 334 J/g**)

Useful Equations:

$$\Delta T = T_f - T_i \qquad C_{p,H_2O} = m \cdot C_{s,H_2O} \qquad C_{s,H_2O} = 4.18 J/g \cdot K$$

$$\Delta H = C_p \cdot \Delta T \qquad \Delta H_{tot} = \Delta H_w + \Delta H_{ice} + \Delta H_{cal} + \Delta H_{fus} = 0 \qquad C_{p,cal} = 50 J/K$$

***Note:** Complete Post Lab questions on page 17 for Heat of Neutralization & Heat of Fusion. *(Skip Question #2 referring to weak acids.)* The Post Lab questions for Heat of Combustion are found on the bottom of the datasheet.

Name: ______________________________ **Section:** _________ **Date:** _______________

Lab Partner: ONLINE

Data Sheet for Heat of Combustion

Tape color on vial of biodiesel: VIOLET

1. Mass of graduated cylinder: ____111.007____ g
2. Mass of water and graduated cylinder: ____159.257____ g
3. Volume of water (d_{water} = 1g/ml) _______________ ml
4. Desired Temperature change = 2000 / Volume of water _______________ ^{o}C
5. Initial Mass of evaporating dish, wick assembly & biodiesel fuel (Mi): _____39.847____ g
6. Final Mass of evaporating dish, wick assembly & biodiesel fuel (Mf): _____39.262____ g
7. Mass of the Biodiesel fuel consumed = Change in Mass (Mf-Mi): _______________ g
8. Initial Temperature of Water: _____22.6______ ^{o}C
9. Final Temperature of Water: _____64.0______ ^{o}C
10. Actual Temperature change of water (Tf-Ti): ______________ ^{o}C
11. Calculate the amount of energy absorbed by the water in the test tube.

    Change in Energy, Δq (joule) = mass of water(g) x specific heat of water (4.184 J/gram ^{o}C) x ΔT (^{o}C)

    Δq _______________(joule)

    Δq _______________(kilojoule)

12. Calculate the Heat of combustion of the fuel from the change in energy of the water and the mass of the biodiesel fuel consumed in kilojoules/gram.

    Heat of combustion (ΔH) = Δq (kilojoule) / mass of biodiesel consumed (g)

    ΔH _______________(kJ/g)

13. The expected value for biodiesel from corn oil was 14.5 kJ/g and the expected value for biodiesel from soy was 9.4 kJ/g. Based on your data, which biodiesel do you presume that you had?

14. List 2 sources of possible errors that could have occurred while doing this experiment.