INTRODUCTION

The beginning: In this experiment, several different experiments will be performed to calculate the enthalpies of various types of reactions. In today's session you will work with your partner to: 1. determine the specific and approximate molar mass of a metal 2. Determine the enthalpy of neutralization of a strong acid and strong base 3. Determine the enthalpy of solution of an unknown salt.

Enthalpy of Various Reactions

The standard heat of formation of a substance, ΔfH°, is defined as the change in enthalpy when one mole of the substance is formed from its elements in their standard states. The standard state is usually defined at a pressure of one bar and a temperature of 25 °C. The enthalpy of any element that is in its standard state and is in its most stable form is arbitrarily given a value of zero. Thus, graphite, which is the most stable form of carbon, has an enthalpy of zero at 25 °C and 1 bar, whereas diamond, another form of carbon but not the most stable at 25 °C and 1 bar, does not have a zero value for enthalpy in the standard state. The standard heat of formation of most simple compounds can be found in the literature. Most of these have been measured experimentally. For example, the standard enthalpy of formation of liquid water at 25 °C can be found from the reaction,
H2 (g) + ½ O2 (g) → H2O (l)
ΔfH° = -68.3 kcal/mol = -285.8 kJ/mol

The standard heat of formation of liquid water is -68.3 kcal/mol or - 85.8 kJ/mol. One calorie is defined as 4.184 Joule. The negative sign in front of the value indicates that heat is released in this reaction and thus it is a exothermic reaction. If the value of the enthalpy is positive, the reaction is endothermic.

Hess' Law can be used to determine the enthalpy of a more complex reaction. The enthalpies of certain reactions cannot be measured in the lab directly. However, it is possible to measure the enthalpies of other reactions which, when added chemically together, give the desired chemical reaction. In such cases, the enthalpies of these reactions can also be added together.

An apparatus called a "calorimeter" is used to measure the quantity of thermal energy gained or lost in a chemical change. A simple calorimeter can be constructed using two nested Styrofoam cups with lids and a thermometer. A more complex type of calorimeter is the bomb calorimeter, which measures thermal energy changes under constant volume conditions. Since we will be working under atmospheric pressure, we will use the first type of calorimeter

One way is to measure a quantity called the specific heat capacity. The specific heat of a substance is the amount of thermal energy required to heat one gram of that substance by one degree. The specific heat capacity of a substance is an intensive property, meaning that it does not depend on the amount of substance present. The specific heat capacity of a drop of water and a pan of water are the same. When we multiply the mass of an object by its specific heat capacity, it is possible to calculate the heat capacity of that object. Heat capacity is an extensive property, meaning that it is dependent on the quantity of substance present. The heat capacity of a drop of water is much, much less than that of a lake. The specific heat capacity of water is unusually high compared to many other substances. This fact has an important impact on us. Cities located near huge bodies of water tend to have more moderate climates. Such cities are cooler in the summer as large water bodies take a long time to absorb the heat of the summer sun, and these cities are warmer in the winter, as the water slowly releases the heat absorbed during the summer. Since our bodies are composed largely of water, we are able to maintain a fairly constant body temperature, in spite of outside temperature fluctuations. In this experiment, the temperature change is small, and we may assume the specific heat capacity to be a constant in this temperature range.

$q = m \times c \times \Delta T$, used to calculate energy required to change the temperature of a substance

$-q$ (metal) = q (water): used when no heat loss to surroundings

$-c_{met} \times m_{met} \times \Delta T_{met} = c_{wat} \times m_{wat} \times \Delta T_{wat}$: equation uses both system and surroundings to calculate change in energy

$c_{met} \times MM_{met} \approx 25$ J/mol°C used to find molor mass once specific heat capacity is known

Enthalpy of Neutralization:

In the neutralization reaction, the same principle is used.
$q_N = - m_{tot} \times c_{soln} \times \Delta T$:
where qN is the total heat energy of neutralization, mtot is the total mass of the solution, csoln is the heat capacity of the solution (which we assume to be the same as that of water), and ΔT is the temperature change.

$\Delta H = q(n)/n(x)$: enthalpy of the reaction per mole of substance,

Enthalpy of Solution:

The dissolution of a salt may be exothermic or endothermic depending on two main factors. The first factor is the lattice energy of the salt. The lattice energy is the energy required to vaporize one mole of the salt to form gaseous ions and this quantity is endothermic. The second factor, the hydration energy, is the energy released when one mole of gaseous ions is solvated by water to form aqueous ions and is exothermic.

$\Delta sH°$ = (- heat loss of H_2O) + (- heat loss of salt) expresses enthalpy of solution and in lab we will use
$\Delta sH° = q_s/n_{salt} = mc\Delta T(\text{solution})/n_{salt}$

Safety Precautions

1. Wear approved eye protection at all times.
2. The acid/base solutions supplied are relatively concentrated. Acids and bases are corrosive. Be careful!!

Materials: refer to experiment 2 lab format

PROCEDURE: refer to experiment 2 lab format

Part 1: Specific Heat Capacity of Metal

	Trial1	Trial2
Mass of Zinc(g)	8.29	8.45
Mass of empty foam cup(g)	2.1260	2.1260
Volume of Distilled water(ml)	20.0	20.0

Description: Zinc appeared silver, solid, and malleable

Part2: Enthalpy of Neutralization (includes both acids)

	Trial1	Trial2
Volume NaOh(ml)	40.0	50.0
Volume HCl(ml)	40.0	50.0
Volume HNO_3(ml)	40.0	50.0
Mass cup and Solution(g)	72.808	91.0122

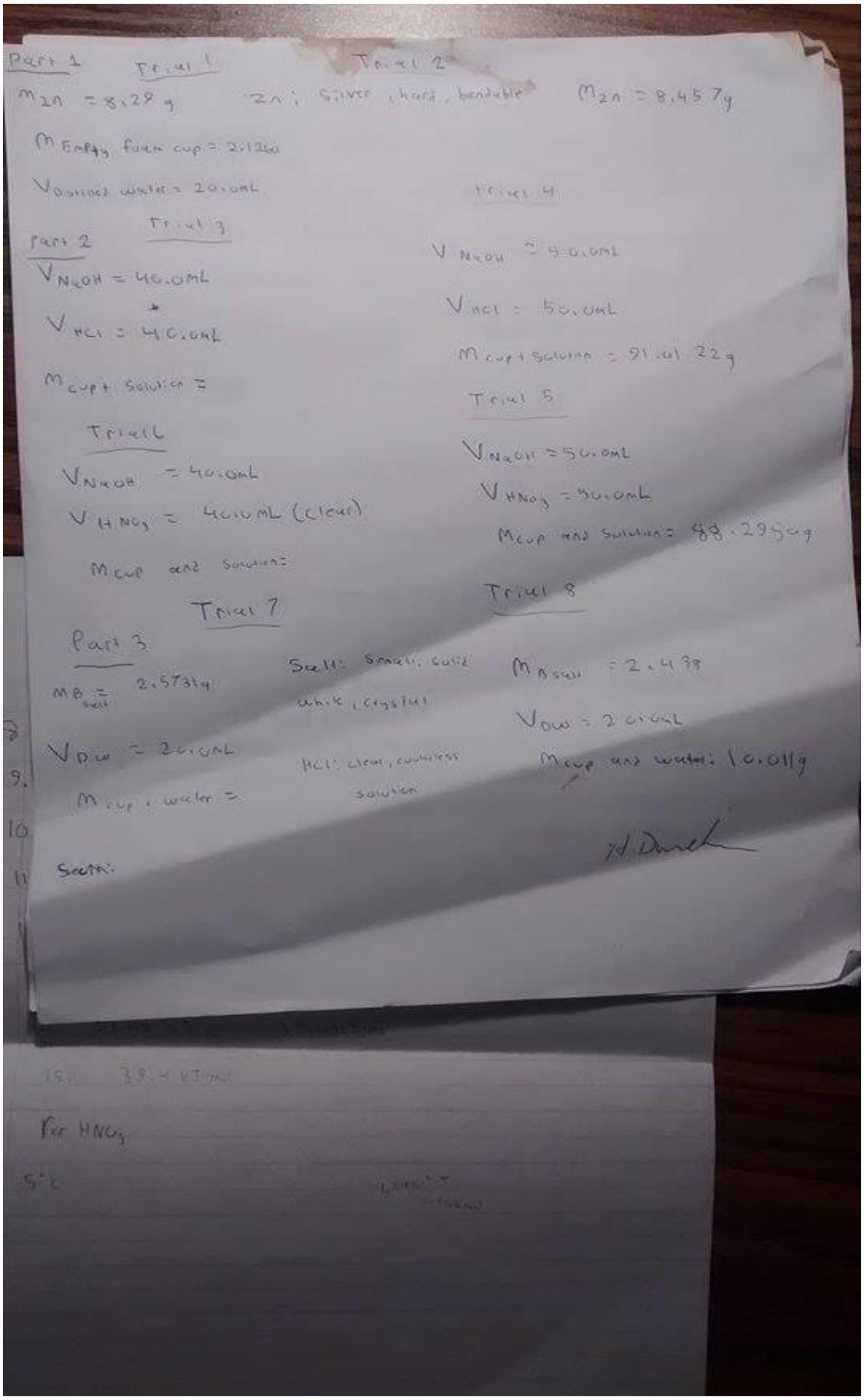
Description: HCl and NaOH appeared as colourless solution

Part3: Enthalpy of Solution

	Trial1	Trial2
Mass Salt B (g)	2.5731	2.438
Volume of distilled water(ml)	20.0	20.0
Mass cup + solution(g)	10.566	10.011

Description: Salt (B): small, white, solid, crystal
HCl: clear, colourless solution

RAW DATA TABLE



Part 1 Trial 1

m_{Zn} = 8.28 g

Zn: Silver, hard, bendable

$m_{Empty\ foam\ cup}$ = 2.126 g

$V_{distilled\ water}$ = 20.0 mL

Trial 2

m_{Zn} = 8.457 g

Part 2 Trial 3

V_{NaOH} = 40.0 mL

V_{HCl} = 40.0 mL

$m_{cup+solution}$ =

Trial 6

V_{NaOH} = 40.0 mL

V_{HNO_3} = 40.0 mL (clear)

$m_{cup\ and\ solution}$ =

Trial 4

V_{NaOH} = 50.0 mL

V_{HCl} = 50.0 mL

$m_{cup+solution}$ = 91.0122 g

Trial 5

V_{NaOH} = 50.0 mL

V_{HNO_3} = 50.0 mL

$m_{cup\ and\ solution}$ = 88.2950 g

Part 3 Trial 7

$m_{B_{salt}}$ = 2.5731 g

V_{DW} = 20.0 mL

$m_{cup+water}$ =

Salt: small, solid white, crystal

HCl: clear, colorless solution

Trial 8

$m_{B_{salt}}$ = 2.438

V_{DW} = 20.0 mL

$m_{cup\ and\ water}$: 10.011 g

Salt:

H. Dunch

8

9.

10

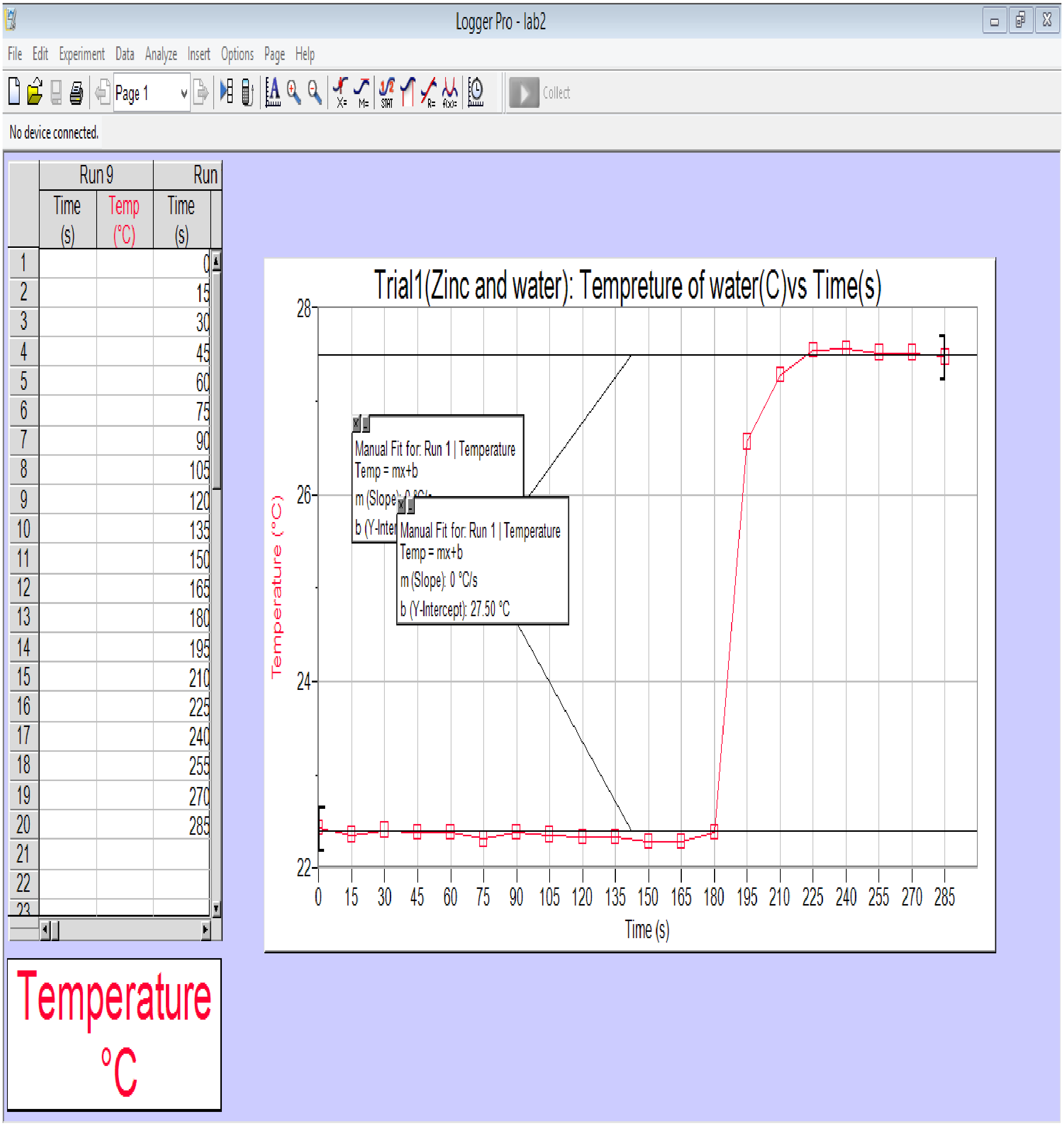
11

15. 38.4 kJ/mol

For HNO_3

5°C

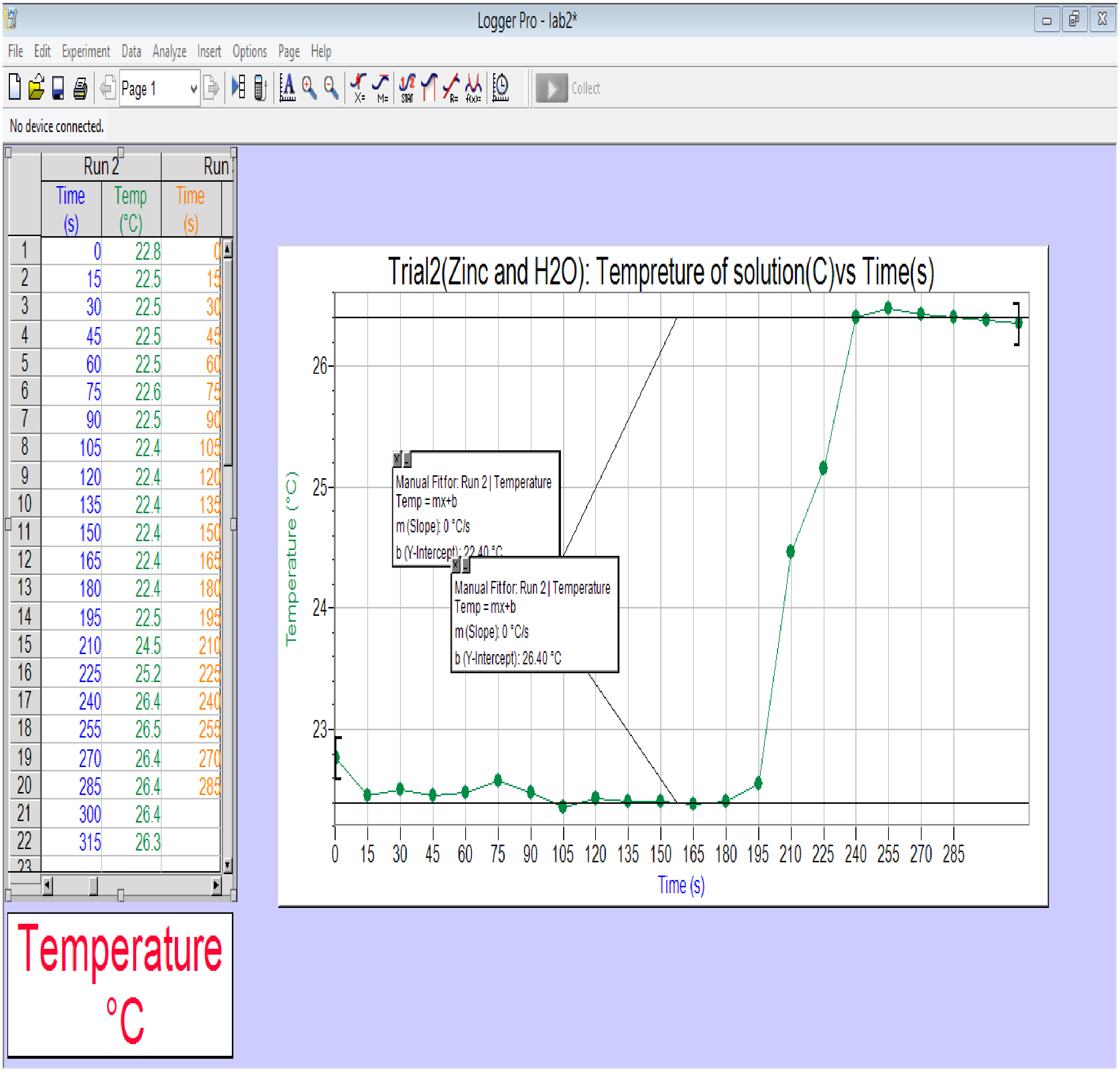
GRAPHS



	Run 9		Run
	Time (s)	Temp (°C)	Time (s)
1			0
2			15
3			30
4			45
5			60
6			75
7			90
8			105
9			120
10			135
11			150
12			165
13			180
14			195
15			210
16			225
17			240
18			255
19			270
20			285
21			
22			
23			

Manual Fit for: Run 1 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Inter

Manual Fit for: Run 1 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 27.50 °C

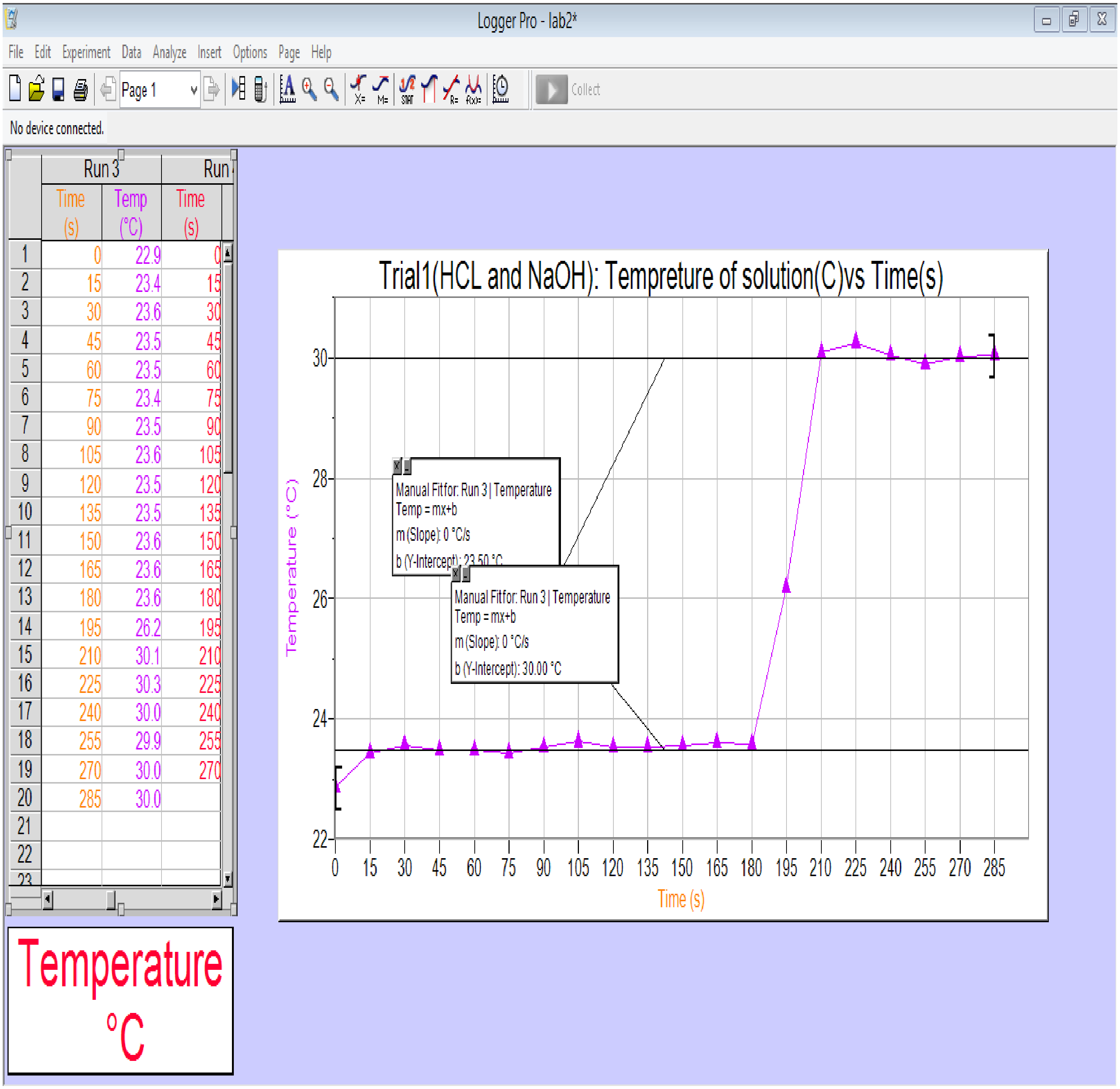


	Run 2		Run
	Time (s)	Temp (°C)	Time (s)
1	0	22.8	0
2	15	22.5	15
3	30	22.5	30
4	45	22.5	45
5	60	22.5	60
6	75	22.6	75
7	90	22.5	90
8	105	22.4	105
9	120	22.4	120
10	135	22.4	135
11	150	22.4	150
12	165	22.4	165
13	180	22.4	180
14	195	22.5	195
15	210	24.5	210
16	225	25.2	225
17	240	26.4	240
18	255	26.5	255
19	270	26.4	270
20	285	26.4	285
21	300	26.4	
22	315	26.3	
23			

Trial2(Zinc and H2O): Tempreture of solution(C)vs Time(s)

Manual Fit for: Run 2 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 22.40 °C

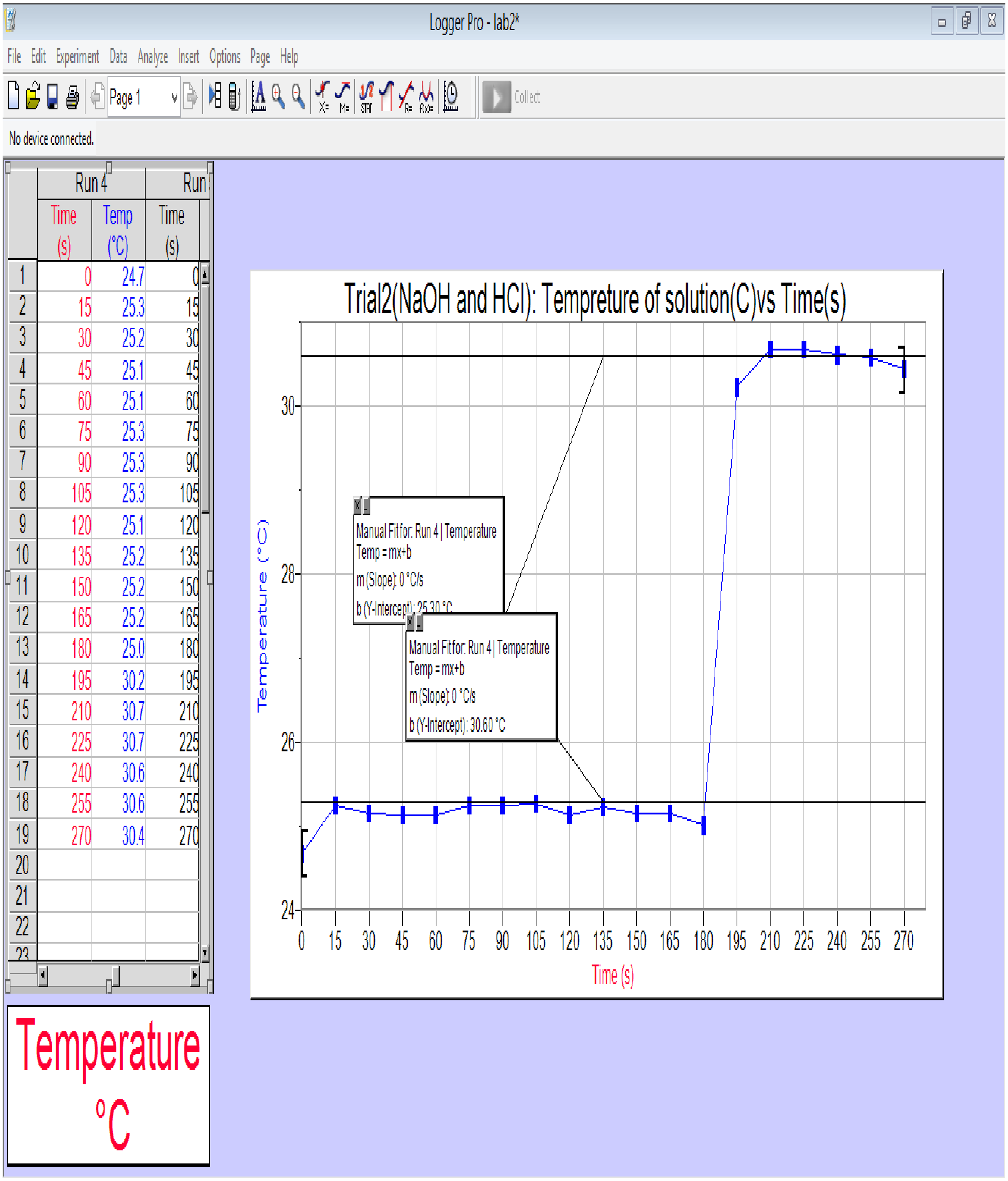
Manual Fit for: Run 2 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 26.40 °C



	Run 3		Run
	Time (s)	Temp (°C)	Time (s)
1	0	22.9	0
2	15	23.4	15
3	30	23.6	30
4	45	23.5	45
5	60	23.5	60
6	75	23.4	75
7	90	23.5	90
8	105	23.6	105
9	120	23.5	120
10	135	23.5	135
11	150	23.6	150
12	165	23.6	165
13	180	23.6	180
14	195	26.2	195
15	210	30.1	210
16	225	30.3	225
17	240	30.0	240
18	255	29.9	255
19	270	30.0	270
20	285	30.0	
21			
22			

Manual Fit for: Run 3 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 23.50 °C

Manual Fit for: Run 3 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 30.00 °C

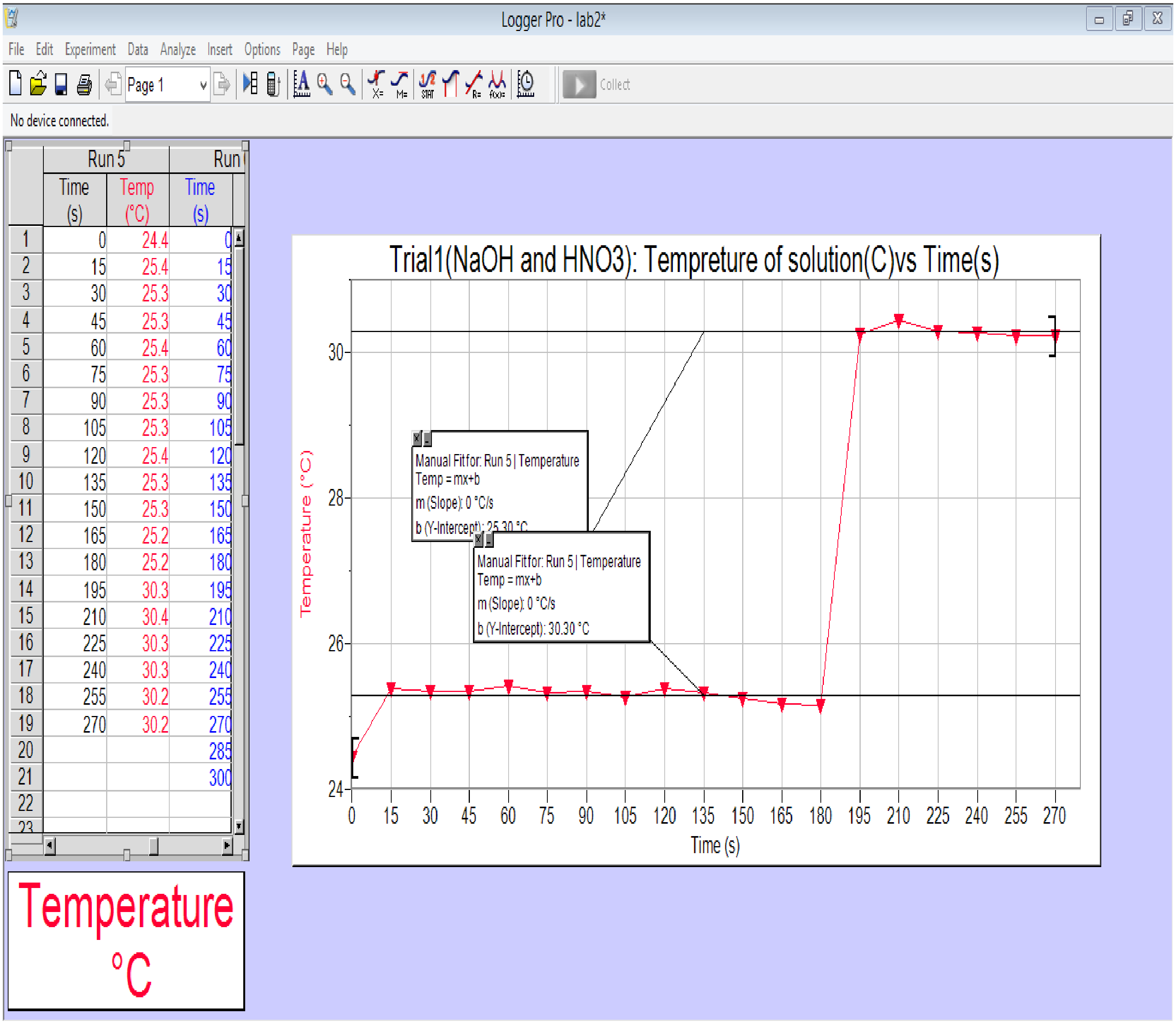


	Run 4		Run
	Time (s)	Temp (°C)	Time (s)
1	0	24.7	0
2	15	25.3	15
3	30	25.2	30
4	45	25.1	45
5	60	25.1	60
6	75	25.3	75
7	90	25.3	90
8	105	25.3	105
9	120	25.1	120
10	135	25.2	135
11	150	25.2	150
12	165	25.2	165
13	180	25.0	180
14	195	30.2	195
15	210	30.7	210
16	225	30.7	225
17	240	30.6	240
18	255	30.6	255
19	270	30.4	270
20			
21			
22			

Trial2(NaOH and HCl): Tempreture of solution(C)vs Time(s)

Manual Fit for: Run 4 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 25.30 °C

Manual Fit for: Run 4 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 30.60 °C



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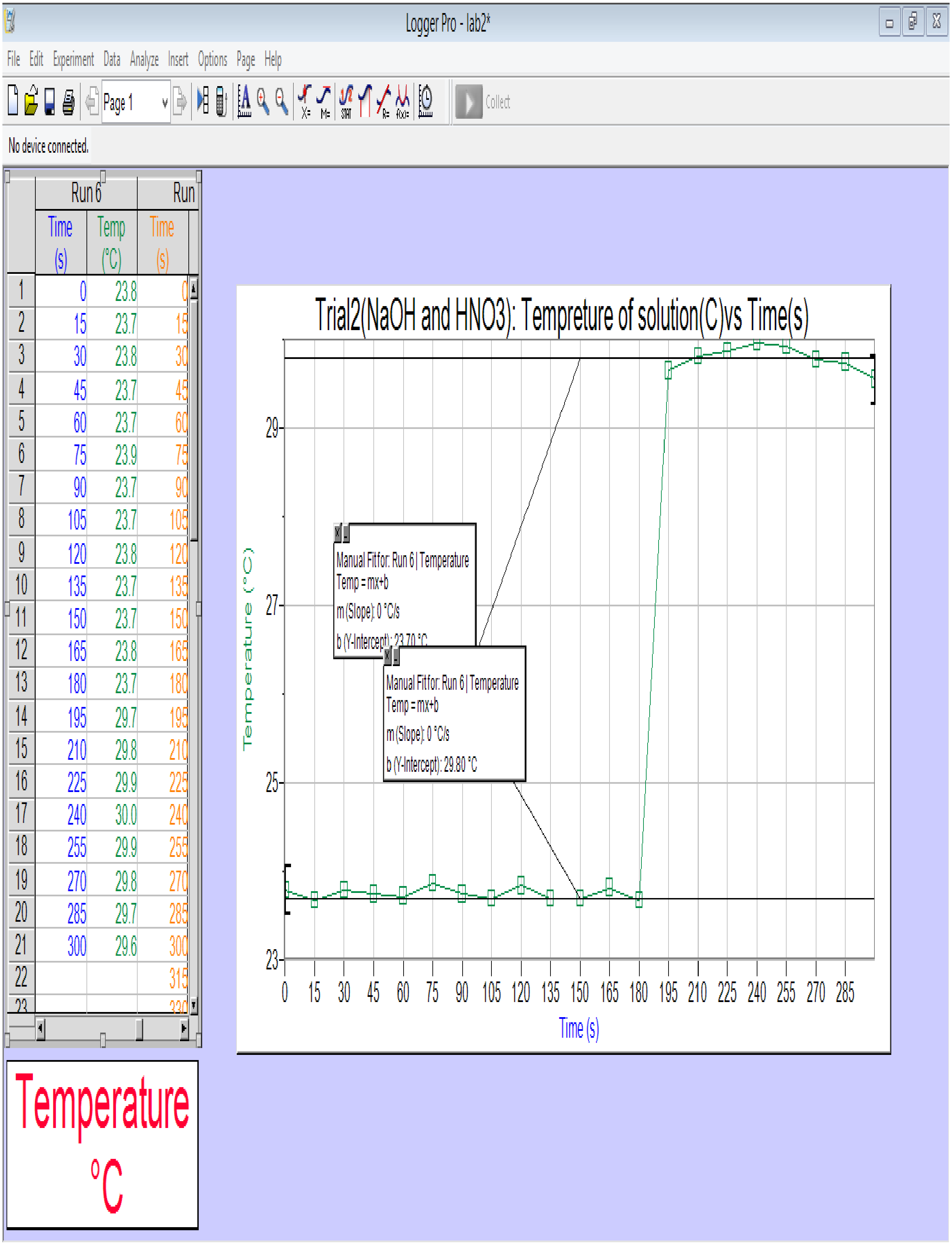
	Run 5		Run
	Time (s)	Temp (°C)	Time (s)
1	0	24.4	0
2	15	25.4	15
3	30	25.3	30
4	45	25.3	45
5	60	25.4	60
6	75	25.3	75
7	90	25.3	90
8	105	25.3	105
9	120	25.4	120
10	135	25.3	135
11	150	25.3	150
12	165	25.2	165
13	180	25.2	180
14	195	30.3	195
15	210	30.4	210
16	225	30.3	225
17	240	30.3	240
18	255	30.2	255
19	270	30.2	270
20			285
21			300
22			
23			

Manual Fit for: Run 5 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 25.30 °C

Manual Fit for: Run 5 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 30.30 °C



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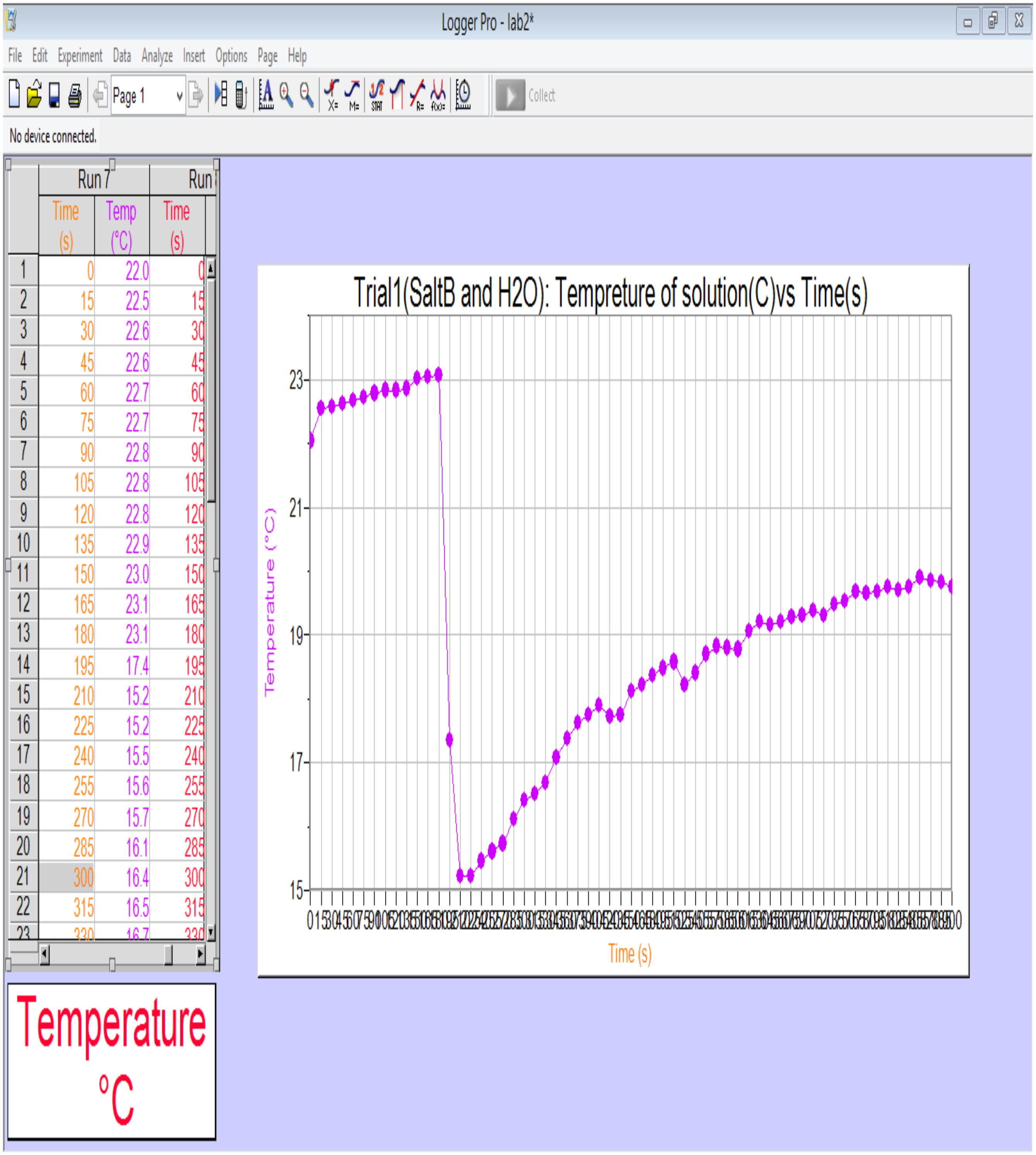
	Run 6		Run
	Time (s)	Temp (°C)	Time (s)
1	0	23.8	0
2	15	23.7	15
3	30	23.8	30
4	45	23.7	45
5	60	23.7	60
6	75	23.9	75
7	90	23.7	90
8	105	23.7	105
9	120	23.8	120
10	135	23.7	135
11	150	23.7	150
12	165	23.8	165
13	180	23.7	180
14	195	29.7	195
15	210	29.8	210
16	225	29.9	225
17	240	30.0	240
18	255	29.9	255
19	270	29.8	270
20	285	29.7	285
21	300	29.6	300
22			315
23			330

Manual Fit for: Run 6 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 23.70 °C

Manual Fit for: Run 6 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 29.80 °C

Temperature
°C



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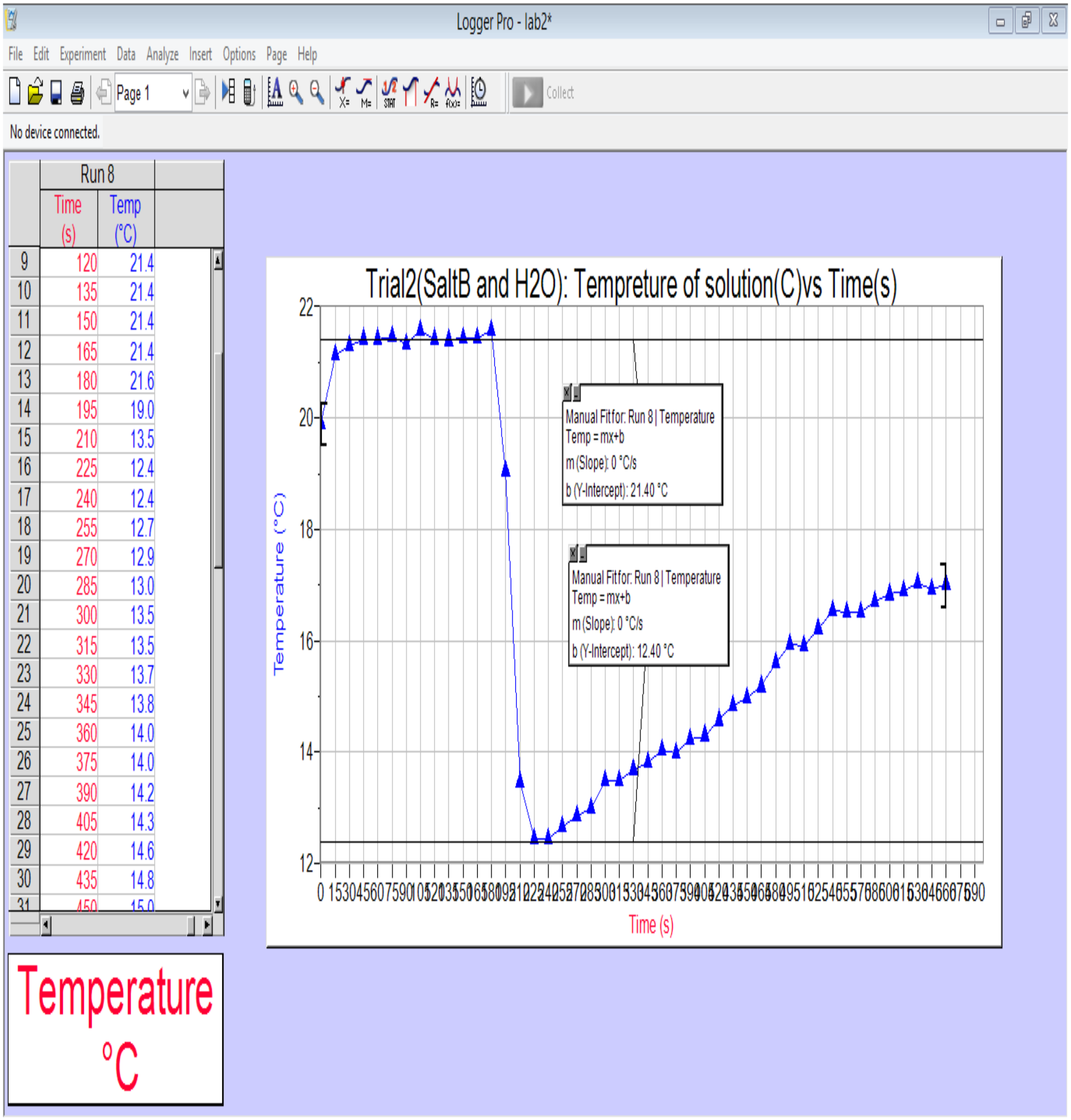
	Run 7		Run
	Time (s)	Temp (°C)	Time (s)
1	0	22.0	0
2	15	22.5	15
3	30	22.6	30
4	45	22.6	45
5	60	22.7	60
6	75	22.7	75
7	90	22.8	90
8	105	22.8	105
9	120	22.8	120
10	135	22.9	135
11	150	23.0	150
12	165	23.1	165
13	180	23.1	180
14	195	17.4	195
15	210	15.2	210
16	225	15.2	225
17	240	15.5	240
18	255	15.6	255
19	270	15.7	270
20	285	16.1	285
21	300	16.4	300
22	315	16.5	315
23	330	16.7	330



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	Run 8	
	Time (s)	Temp (°C)
9	120	21.4
10	135	21.4
11	150	21.4
12	165	21.4
13	180	21.6
14	195	19.0
15	210	13.5
16	225	12.4
17	240	12.4
18	255	12.7
19	270	12.9
20	285	13.0
21	300	13.5
22	315	13.5
23	330	13.7
24	345	13.8
25	360	14.0
26	375	14.0
27	390	14.2
28	405	14.3
29	420	14.6
30	435	14.8
31	450	15.0

Manual Fit for: Run 8 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 21.40 °C

Manual Fit for: Run 8 | Temperature
Temp = mx+b
m (Slope): 0 °C/s
b (Y-Intercept): 12.40 °C

Calculations

Part 1(Enthalpy of Various Reactions)

1. $\Delta T_{water} = T_{final} - T_{initial}$

$\Delta T_{water} = 27.5℃ - 22.4℃$

$\boldsymbol{\Delta T_{water} = 5.1}℃$

Trial2: $\boldsymbol{\Delta T_{water} = 3.9}℃$

2. $q_{water} = m_w c_w \Delta T_w$

$q_{water} = (20.0mL \times 1.0g/mL)(4.184J/g℃)(5.10℃)$

$q_{water} = 426.77J$

$\boldsymbol{q_{water} = 427J}$

Trial 2: $\boldsymbol{q_{water} = 326J}$

3. $\Delta T = T_2 - T_1$

$\Delta T = 27.5℃ - 100℃$

$\boldsymbol{\Delta T = -72.5}℃$

Trial2: $\boldsymbol{\Delta T = -73.6}℃$

4. $c_{zn} = \frac{q_{zn}}{m_{zn} \times \Delta T}$

$$c_{zn} = \frac{-426.77J}{8.291g \times -72.5℃}$$

$\boldsymbol{c_{zn} = 0.710J/g}℃$

Trial2: $\boldsymbol{c_{zn} = 0.524J/g}℃$

5. $c_{Zn} \times MM_{Zn} \cong 25J/mol℃$

$0.710J/g℃ \times MM_{Zn} \cong 25J/mol℃$

$\boldsymbol{MM_{Zn} \cong 35.2g/mol}$

Trial2: $\boldsymbol{MM_{Zn} \cong 47.7g/mol}$

6. $\%error_{cZn} = \frac{Experimental}{Theoretical} \times 100\%$

$$\%error_{cZn} = \frac{0.710J/g℃}{0.39J/g℃} \times 100\%$$

$\boldsymbol{\%error_{cZn} = 182\%}$

$$\%error_{MMZn} = \frac{35.2g/mol}{65.38g/mol} \times 100\%$$

$\boldsymbol{\%error_{MMZn} = 53.8\%}$

Trial2:

$\boldsymbol{\%error_{cZn} = 134\%}$

$\boldsymbol{\%error_{MMZn} = 72.9\%}$

7. No, the mass of the metal used does not make a difference. It shouldn't have because when calculating specific heat capacity, the mass will just cancel out as it is same value as numerator and denominator.

Part 2(Part2: Enthalpy of Neutralization)

8. $\Delta T_{solution} = T_{final} - T_{initial}$

$\Delta T_{solution} = 30.0℃ - 23.5℃$

$\boldsymbol{\Delta T_{solution} = 6.5℃}$

Trial2: $\Delta\boldsymbol{T}_{\boldsymbol{solution}} = \mathbf{5.3}℃$

9. $m_{solution} = m_{sol\&cup} - m_{cup}$

$m_{solution} = 72.808g - 2.1260g$

$m_{solution} = \frac{70.682g}{1g/mL} = V_{sol}$

$\boldsymbol{V_{sol} = 70.682mL}$

Trial2: $\boldsymbol{V_{sol} = 88.886mL}$

10.

$m_{sol} = D_{sol}V_{sol}$

$m_{sol} = 1.0g/mL \times 70.682mL$

$\boldsymbol{m_{sol} = 70.682g}$

Trial2: $\boldsymbol{m_{sol} = 88.886g}$

The measured mass of the solution and the volume of the solution are the value thus neither is more accurate. This is why it doesn't matter which value you choose.

11.

$q_{sol} = m_{sol}c_{sol}\Delta T$

$q_{sol} = 70.682g \times 4.184J/g℃ \times 6.5\ ℃$

$q_{sol} = 1922.27J$

$\boldsymbol{q_{sol} = -1.9 \times 10^4 J}$

Trial2: $\boldsymbol{q_{sol} = -1.9 \times 10^4 J}$

12. $n_{NaOH} = \frac{c_{NaOH}}{V_{NaOH}}$

$$n_{NaOH} = \frac{1.0mol/L}{40mL \times \frac{1L}{1000mL}}$$
$$\boldsymbol{n_{NaOH} = 0.04\ mol}$$

Since, NaOH → Na^+ + OH^-

1 mol NaOH = 1 mol OH^-

Thus, n_{OH^-} = 0.04mol

Trial2: n_{OH^-} = 0.05mol

13.

Since NaOH (aq) + HCL (aq) → H_2O (aq) + NaCl (aq)

Thus 0.04mol n_{NaOH} = 0.04mol n_{H2O}

Trial2: n_{H2O}=0.05mol

14.

$\Delta H^\circ = q_{sol} / n_{H2O}$-

ΔH° = -1922.27 J / 0.04 mol

ΔH° = -48056.75 J x (1kJ/1000J)

ΔH° = -48.1kJ/mol

Trial2: ΔH° = -39.4kJ/mol

15.

for HCL:

Since NaOH (aq) + HCL (aq) → H_2O (aq) + NaCl (aq)
This 0.04mol n_{NaOH} = 0.04mol n_{HCL}

$\Delta H^\circ = q_{sol} / n_{HCL}$-

ΔH° = -1922.27 J / 0.04 mol

ΔH° = -48056.75 J x (1kJ/1000J)

ΔH° = -48.1kJ/mol

Trial2: ΔH° = -39.4kJ/mol

For HNO_3:

$\Delta T_{solution} = T_2 – T_1$
$\Delta T_{solution}$ = 29.9 - 23.7
$\Delta T_{solution}$ =6.2°C

$m_{solution} = m_{sol+cup} - m_{cup}$
$m_{solution}$ = 62.495g – 2.1260g
$m_{solution}$ = 60.369 / 1g/mL = V_{sol}
V_{sol} = 60.369 mL
m_{sol} = 60.369 mL x 1.00g/mL
m_{sol} =60.369g

$q_{sol} = m_{sol}c_{sol}\Delta T$
q_{sol} = 60.369 x 4.184J/ °C x 6.2 °C

q_{sol} = -1566.02J
q_{sol} = -1.6×10^4 J

$n_{HNO3} = c_{HNO3}/v_{HNO3}$
n_{HNO3} = 1.1mol/L / (40.0mL x 1L/1000mL)
n_{HNO3} = 0.044mol

$\Delta H^\circ = q_{sol} / n_{HNO3^-}$

ΔH° = -1566.02 J / 0.044 mol

ΔH° = -35591.36 J x (1kJ/1000J)

ΔH° = -35.6 kJ/mol

Trial2: ΔH° = -34.5 kJ/mol

16.

for HCL:

% error = |theoretical - actual| / theoretical x 100%

%error = |-57.1kJ/mol – 48.1kJ/mol| / -57.1kJ/mol x 100%

$\%error_{HCL}$ = 15.8%

Trial2: $\%error_{HCL}$ = 21.2%

for HNO_3:

% error = |theoretical - actual| / theoretical x 100%

%error = |-57.3kJ/mol – 35.6kJ/mol| / -57.3kJ/mol x 100%

$\%error_{HNO3} = 37.9\%$

Trial2 $\%error_{HCL} = 39.7\%$

17.

The two trials for the acids yielded similar results and yes they should have. The values for enthalpies of neutralization (for HCL: $\Delta H^\circ = -48.1$kJ/mol and for HNO_3 $\Delta H^\circ = -35.6$ kJ/mol), had different results. I did not expect the results I obtained as I was expecting the two acids to have very similar results due to similar number of moles for each acid.

Part 3 Enthalpy of Solution

18.

$\Delta T_{solution} = T_2 – T_1$

$\Delta T_{solution} = 12.4 - 21.4$

$\Delta T_{solution} = -9.0°C$

Trial2: **$\Delta T_{solution}$ =-7.6°C**

19.

$q_{sol} = m_{sol}c_{sol}\Delta T$

q_{sol} = 2.438g x 3.662J/g °C x -9.0 °C

q_{sol} = -80.35J

$q_{sol} = -8.0 \times 10^{-2}$ kJ

Trial2: $q_{sol} = -7.2 \times 10^{-2}$ kJ

20.

$n_{saltB} = m_{saltB} / MM_{saltB}$

n_{saltB} = 2.438g / 166.0g/mol

n_{saltB} =0.0147 mol

trial2: n_{saltB} =0.0155mol

$\Delta H° = q_{sol} / n_{saltB}$

$\Delta H°$ = -80.35J / 0.0147 mol

$\Delta H°$ = -5465.99 J x (1kJ/1000J)

$\Delta H°$ = -5.47 kJ/mol

Trial2: $\Delta H°$ = -4.62KJ/mol

21.

Salt is Potassium Iodide by searching the molar mass 166.0g/mol and salt.

The Enthalpy of the solution was found to be 20.15 kJ/mol

http://nvlpubs.nist.gov/nistpubs/jres/84/jresv84n4p273_A1b.pdf

for KI:

% error = |theoretical - actual| / theoretical x 100%

%error = |-20.15kJ/mol –(-5.47kJ/mol)| / -20.15kJ/mol x 100%

%error = 72.9%

Trial 2: **%error = 77.1%**

22. The mass does not affect the result and it shouldn’t have because you can use any mass to calculate the enthalpy and you will always get the same value, unlike if the temperature altered, then you get different results.

Discussion

Specific Heat Capacity

The specific heat capacity of zinc was found to be 0.710J/g°C and a molar mass of 35.2 g. When comparing both trials there are slight differences in both heat capacity and molar mass, this is due to the fact that there was different temperature change for the second trial. Sources of error that would cause this include the calorimeter not isolating the substances fully and because of that some of gas from reaction may have escaped into atmosphere which affects calculations.

Enthalpy of neutralization

For HCL ΔH° = -39.4kJ/mol, for HNO_3 ΔH° = -35.6 kJ/mol. Both these values are very similar and theoretically should be almost the same as the same number of moles of each acid was used. When comparing both trials for each acid it was found that similar results (not identical) were yielded. This is due to sources of error which again include that the system of the calorimeter used in the lab was not perfect, for example when mixing the chemicals, the lid of the calorimeter had to be quickly opened and then closed, however in that time some of the reactions gases may have escaped thus not giving the most accurate results.

Enthalpy of solution

The enthalpy of solution was found to be ΔH° = -5.47 kJ/mol with a percent error of 72.9%. When comparing both trials there was a slight difference in the enthalpy, this is due to a slightly different temperature change and sources of error. These errors include again not having a perfect calorimeter setup, thus when mixing chemicals, some gases were lost in atmosphere. The three parts of the experiment directly link back with the theory as through various different reactions, different enthalpies of solutions were found in different situations.

Conclusion

For part1: The specific heat capacity of zinc was found to be 0.710J/g°C and a molar mass of 35.2 g. also the %error for specific heat capacity was 182% and %error for molor mass of zinc was 53.8%

For part2: The enthalpy of neutralization for HCL ΔH° = -39.4kJ/mol, for HNO_3 ΔH° = -35.6 kJ/mol. The %error for HCl was 15.8% and for HNO_3 was 37.9%

For Part3: The enthalpy of solution was ΔH° = -5.47 kJ/mol with a percent error of 72.9%.