

Course no: CHEM 118

Experiment no:

Group no: 6

Student ID : 2405029

Partner's ID : 2405007

Name of the experiment: CALORIMETRIC DETERMINATION OF HEAT OF
DISSOLUTION REACTIONS (HEATS OF DISSOCIATION)

Date of Performance: 26.01.2026

Date of Submission :

Introduction:

Chemical reactions involve the making and breaking of bonds, processes inherently associated with energy changes. These energy changes can manifest as heat, which is either absorbed/released into the surroundings. When a solid ionic compound dissolves in water, a complex interplay of forces determines the overall heat change. The theory underlying these processes is rooted in the concepts of enthalpy, entropy and the energetics of solute-solvent interactions.

• Enthalpy:

Enthalpy (ΔH) tracks how heat moves between the chemical system and its surroundings. In exothermic ($\Delta H < 0$), the system releases heat because the energy released when ions bond with water is greater than the energy needed to pull the solid apart. Where, endothermic is vice-versa

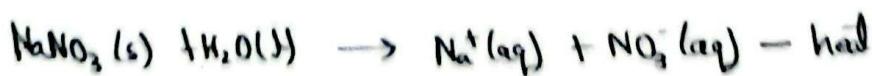
• Dissolution process:

Disruption of Ionic Lattice (Endothermic) — ionic bonds in the solid lattice must be broken, which requires a significant amount of energy. This energy is known as the lattice energy (U), which is always positive.

Hydration of Ions (Exothermic) — once free, ions are solvated by water. Because water is polar, its partial charges attract the ions. This sticking process is exothermic and releases energy ($\Delta H_{hydration}$).

• Net Enthalpy Change (ΔH_{soln}):

$$\Delta H_{solution} = U + \Delta H_{hydration}$$



The dissolution of ionic compounds also involves changes in entropy (ΔS), which is a measure of disorder. Even if a dissolution process is endothermic, it may still occur spontaneously if the increase in entropy is significant. Dissolution generally increases the disorder of the system because the structured ionic lattice breaks down into freely moving ions in solution. The Gibbs free energy (ΔG), given by, $\Delta G = \Delta H - T\Delta S$, ultimately determines the spontaneity of the dissolution.

Name of the Chemicals:

- $MgSO_4$
- $NaNO_3$
- Distilled water

List of Apparatus:

- Calorimeter
- Thermometer
- Measuring cylinder

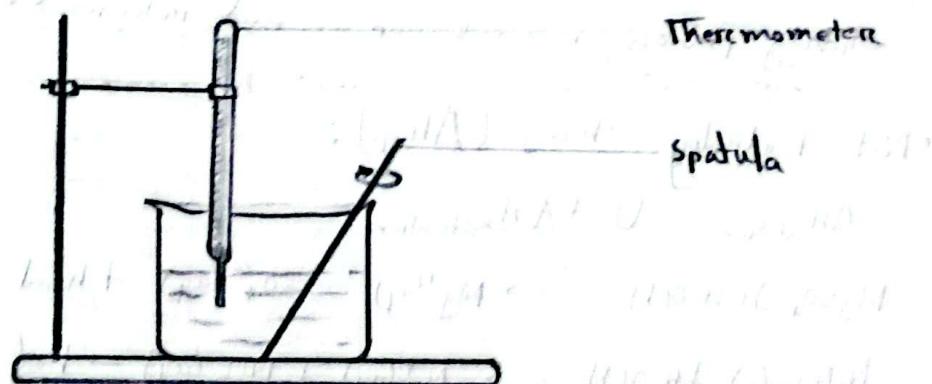


Fig: Calorimetric Determination of heat of dissolution reaction

Data :

Table-1: Observation of temperature over time for $MgSO_4$

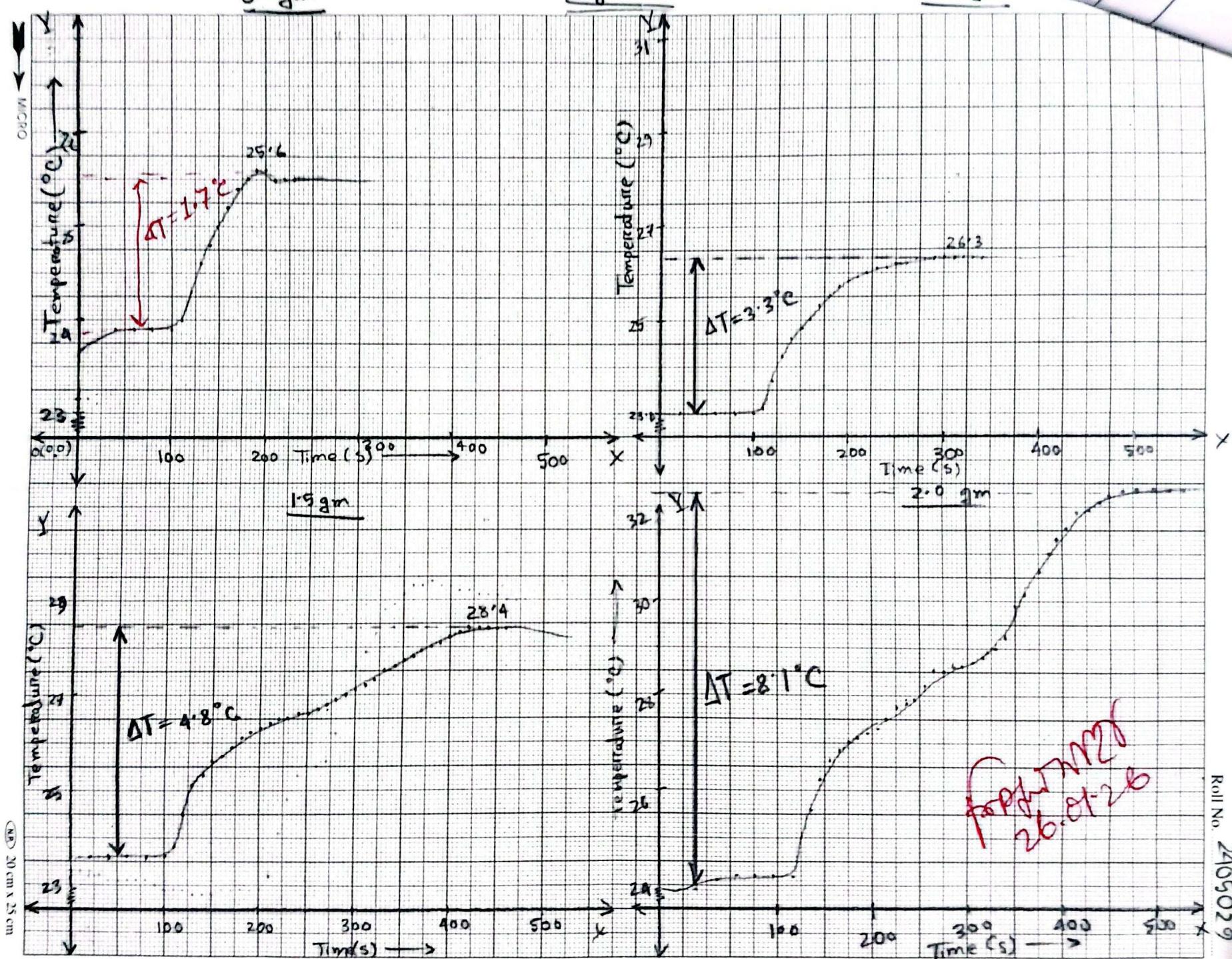
Mass of $MgSO_4$ (0.5gm)	Mass of $MgSO_4$ (0.5gm)	Mass of $MgSO_4$ (1.0gm)	Mass of $MgSO_4$ (1.0gm)
Mass (gm) Time (s)	Temp (°C)	Time (s)	Temp (°C)
0	23.3	230	25.5
20	23.8		20
40	23.9		40
60	23.9		60
80	23.9		80
100	23.9		100
110	24.0		110
120	24.3		120
130	24.6		130
140	24.8		140
150	25.0		150
160	25.2		160
170	25.4		170
180	25.5		180
190	25.6		190
200	25.6		200
210	25.5		210
220	25.5		220

Mass of $MgSO_4$ (1.5gm)	Mass of $MgSO_4$ (1.5gm)	Mass of $MgSO_4$ (2.0gm)	Mass of $MgSO_4$ (2.0gm)
Mass (gm) Time (s)	Temp (°C)	Time (s)	Temp (°C)
0	23.6	260	26.8
20	23.6	270	26.9
40	23.6	280	27
60	23.6	290	27.1
80	23.6	300	27.2
100	23.6	310	27.3
110	23.8	320	27.3
120	24.5	330	27.5
		340	27.6
130	25.1	350	27.7
140	25.3	360	27.8
150	25.6	370	27.9
160	25.7	380	28
170	25.9	390	28.1
180	26.1	400	28.2
190	26.2	410	28.3
200	26.3	420	28.4
210	26.4	430	28.4
220	26.5		260
230	26.5		270
240	26.6		280
250	26.7		290

Table-2: Observation of Temperature of NaNO_3 over time

Mass of NaNO_3 (0.5g)	Mass of NaNO_3 (0.5g)	Mass of NaNO_3 (1.0gm)	Mass of NaNO_3				
Time(s)	Temp(°C)	Time(s)	Temp(°C)	Time(s)	Temp(°C)	Time(s)	Temp(°C)
0	24.1	210	23.9	0	24.5	190	23.8
20	24.1	220	23.9	20	24.6	200	23.8
40	24.1	230	23.9	40	24.6	210	23.7
60	24.1	240	23.9	60	24.5	220	23.7
80	24.1	250	23.9	80	24.5	230	23.7
100	24.0	260	23.9	90	24.4	240	23.6
120	23.8	270	23.9	100	24.2	250	23.6
130	23.8	280	24.0	110	24.1	260	23.6
140	23.8	290	24.0	120	24.0	270	23.6
150	23.8	300	24.0	130	24.0	280	23.6
160	23.7	310	24.1	140	24.0	290	23.6
170	23.8	320	24.1	150	24.0	300	
180	23.8			160	24.0		
190	23.8			170	23.9		
200	23.8			180	23.9		

Mass of NaNO_3 (1.5gm)	Mass of NaNO_3 (1.5gm)	Mass of NaNO_3 (2.0gm)	Mass of NaNO_3 (2.0g)	Time(s)	Temp (°C)
Time(s)	Temp(°C)	Time(s)	Temp(°C)	Time(s)	
0	23.3	230	23.2	0	22.8
20	24.4	240	23.1	20	24.1
40	24.5	250	23.1	40	24.3
60	24.5	260	23.1	60	24.5
80	24.5	270	23.1	80	24.5
90	24.5	280	23.1	90	24.3
100	24.4	290	23.1	100	23.5
110	24.3	300	23.1	110	23.3
120	24.1			120	23.1
130	23.8			130	22.8
140	23.8			140	22.6
150	23.6			150	22.3
160	23.6			160	22.1
170	23.5			170	22.1
180	23.3			190	22.1
190	23.3			200	22.1
200	23.3			210	22.1
210	23.2				
220	23.2				



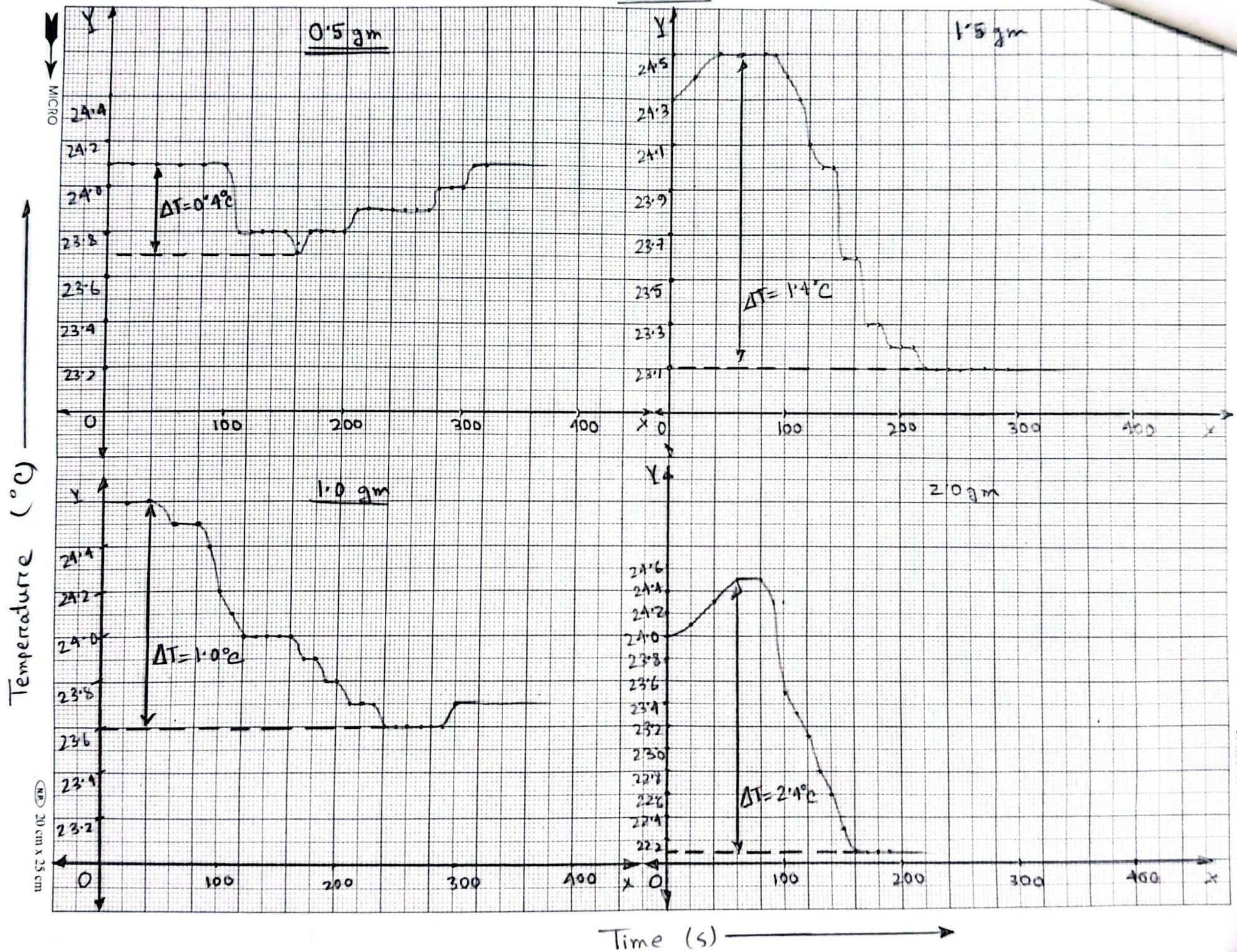
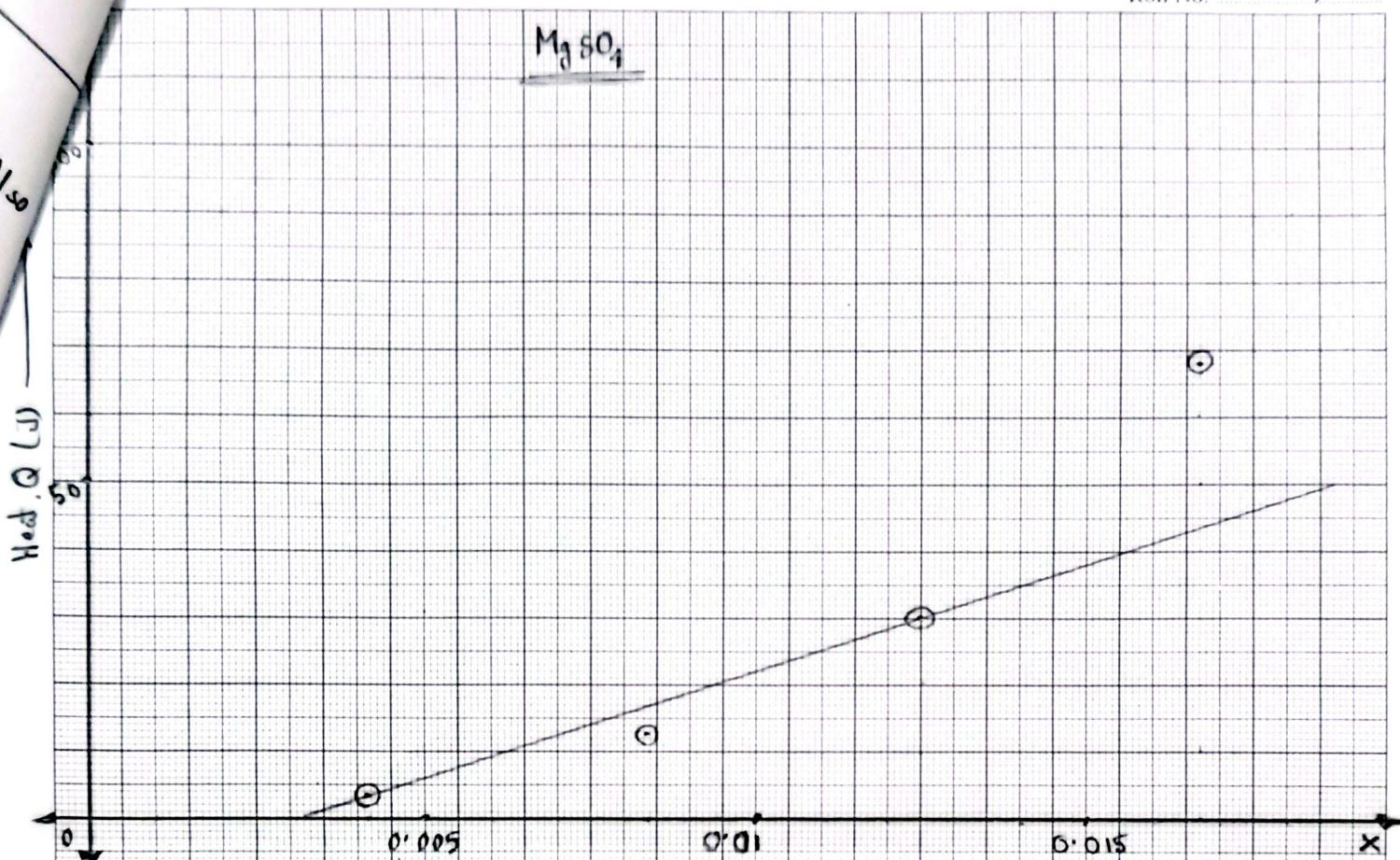
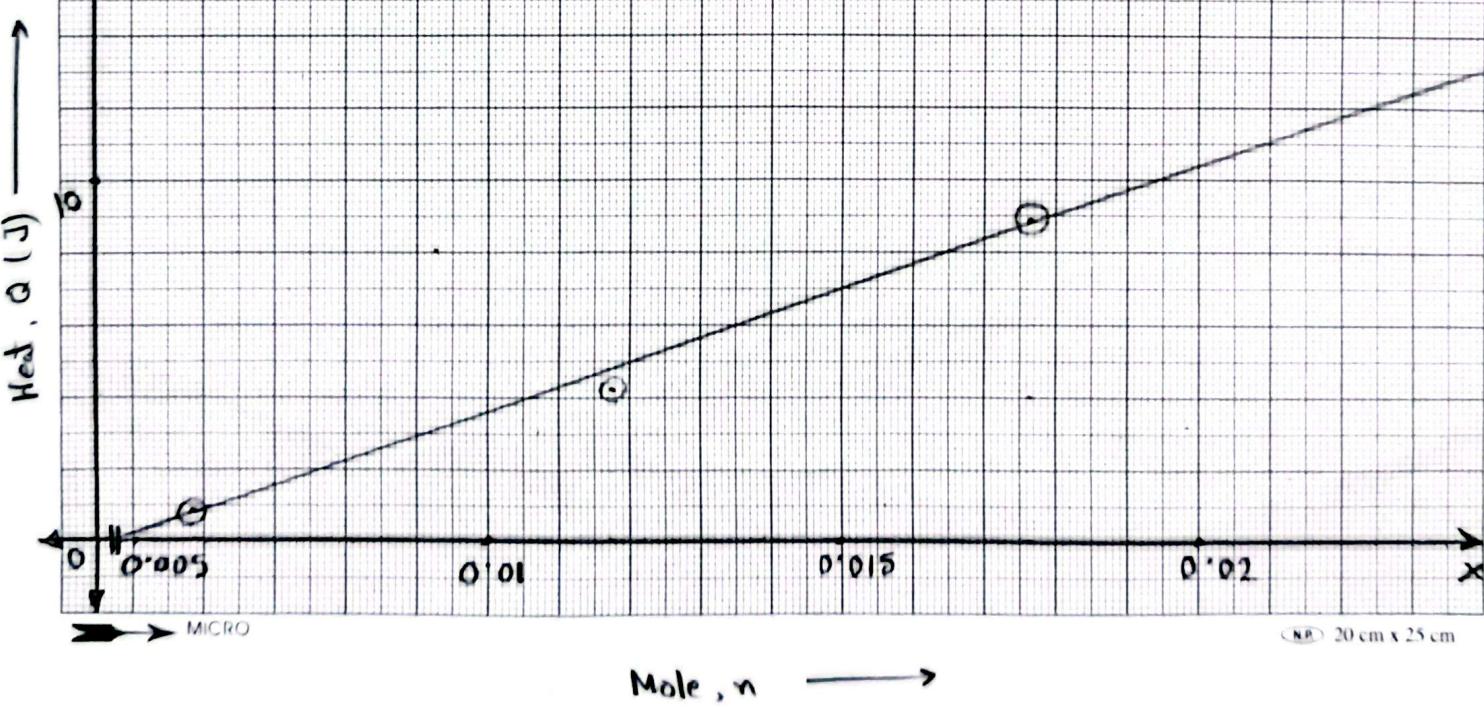
NaNO_3 

Table - 3 : Heat and Mole for $MgSO_4$ ($M_A = 120$ g/mole)

Mass, M ($\times 10^{-3}$ kg)	Heat, $Q = CM\Delta T$ (J)	Moles, $n = \frac{M}{M_A}$
0.5	$Q = 0.5 \times 10^{-3} \times 4200 \times 1.7 = 3.57$	0.00325 0.004167
1.0	$Q = 1 \times 10^{-3} \times 4200 \times 3.3 = 13.86$	0.00833
1.5	$Q = 1.5 \times 10^{-3} \times 4200 \times 4.8 = 30.24$	0.0125
2.0	$Q = 2.0 \times 10^{-3} \times 4200 \times 8.1 = 68.04$	0.0167

Table-4: Heat and mole calculation for $NaNO_3$ ($M_B = 85$ g/mole)

Mass, M ($\times 10^{-3}$ kg)	Heat, $Q = CM\Delta T$ (J)	Moles, $n = \frac{M}{M_B}$
0.5	$Q = 0.5 \times 10^{-3} \times 4200 \times 0.4 = 0.84$	0.005882
1.0	$Q = 1 \times 10^{-3} \times 4200 \times 1 = 4.2$	0.011765
1.5	$Q = 1.5 \times 10^{-3} \times 4200 \times 1.4 = 8.82$	0.01765
2.0	$Q = 2 \times 10^{-3} \times 4200 \times 2.4 = 20.16$	0.02353

MgSO₄NaNO₃

Discussion:

The room temperature varied a little in every experiment. Also the time to stir the salts properly was not same everytime, which may have resulted in the Q vs n graph error.

The graph was supposed to be a pure straight line but it missed one point greatly, because of experimental error or wrong amount of substances used or faulty measuring systems.

Name of F

No. of Exp. 04

Name of Experiment: CALORIMETRIC DETERMINATION
OF HEAT OF DISSOLUTION REACTIONS
(HEATS OF DISSOCIATION)

Name: Sojut Ardin Khan; ID: 2905027; Section: A1

Course: CHE 116 Date: 26/01/26

MgSO₄ (0.5 g^m)

Time(s)	Temperature (°C)	Time(s)	Temperature (°C)
0	23.3	170	25.4
20	23.8	180	25.5
40	23.9	190	25.6
60	23.9	200	25.6
80	23.9	210	25.5
100	23.9	220	25.5
110	24.0	230	25.5
120	24.3		$\Delta T = 1.7^{\circ}\text{C}$
130	24.6		
140	24.8		
150	25.0		
160	25.2		

FORMER
26.01.26

Name: Rakibul Hasan Rizat

Roll: 2905019

Date: 26/01/2026

Exp name: calorimetric determination of heat of dissolution reactions (Heats of Dissolution)

DATATABLE 1: Observation of temperature overtime interval

(Mass of $MgSO_4$ - 0.5gm)

Time(s)	Temp ($^{\circ}C$)
220	26
230	26.1
240	26.1
250	26.2
260	26.2
270	26.3
280	26.3
290	26.3
300	26.3
310	26.3
320	26.3
330	26.3
340	26.3

(Mass of $MgSO_4$ 1.0gm)

Time(s)	Temp ($^{\circ}C$)
0	23.1
20	23.0
90	23.0
60	23.0
80	23.0
100	23.0
110	23.1
120	23.2
130	24.2
140	24.6
150	24.8
160	25
170	25.3
180	25.5
190	25.8
200	25.8
210	25.9

No. of Exp : 04

Name of Experiment: Calorimetric determination of heat of dissolution reaction. (Heats of dissociation)

d.

Table: Observation of Temperature Over time Intervals

Mass of $MgSO_4$ 1.5 g	Time (s)	Temp ($^{\circ}C$)	Time (s)	Temp ($^{\circ}C$)
	250	26.6	0	23.6
	260	26.7	20	23.7
	270	26.8	40	23.8
	280	26.9	60	23.9
	290	27	80	23.9
	300	27.1	100	23.9
	310	27.2	110	23.9
	320	27.3	120	24.5
	330	27.5	130	25.1
	340	27.6	140	25.3
	350	27.7	150	25.6
	360	27.8	160	25.7
	370	27.9	170	25.9
	380	28	180	26.1
	390	28.1	190	26.2
	400	28.2	200	26.3
	410	28.3	210	26.4
	420	28.4	220	26.5
	430	28.4	230	26.5

$$\Delta T = 4.8^{\circ}C$$

for 1.5 g
26.01.20

Name: Ahmad Taqie Abir

ID: 2405018

Course: CHE-116

Section: A1

Date: 26.01.2026

No. of Exp: 04

Name of Exp: CALORIMETRIC DETERMINATION OF HEAT
 OF DISSOLUTION REACTIONS (HEATS OF
 DISSOCIATION). 2.0 gm

Mass of $MgSO_4$ (2.0g)	Mass of $MgSO_4$ (2.0g)	Time (s)	Temp (°C)	Time (s)	Temp (°C)
0	22.7	340	28.8		
20	23.9	350	28.9		
40	24.1	360	29.6		
60	24.1	370	29.3		
80	24.2	380	29.8		
100	24.2	390	30.1		
120	24.2	400	30.6		
140	24.2	410	31.0		
150	25.6	420	31.3		
160	25.6	430	31.5		
170	26.2	440	31.8		
180	26.6	450	31.9		
190	26.8	460	32.1		
200	27.0	470	32.2		
210	27.1	480	32.3		
220	27.2	490	32.3		
230	27.3	500	32.3		
240	27.5	510	32.3		
250	27.7	520	(32.3)		
260	27.8				
270	27.9				
280	28.2				
290	28.5				
300	28.5				
310	28.6				
320	28.6				
330	28.7				

$$\Delta T = 8.1^\circ C$$

for M.J.W.D
26-01-26

No. of Exp: 04

Name of Experiment: CALORIMETRIC DETERMINATION OF HEAT OF DISSOLUTION REACTIONS (HEATS OF DISSOCIATION)

Name: Md. Shabit Zaman; ID: 2905013; Section: A1; Course No.: CHBN116

Date: 26/01/2026

Mass of NaNO_3 (0.5g)

Time(s)	Temperature($^{\circ}\text{C}$)	Time(s)	Temperature($^{\circ}\text{C}$)
20	24.1	280 220	23.9
90	24.1	290 230	23.9
60	24.1	300 240	23.9
80	24.1	310 250	23.9
100	24.0	320 260	23.9
120	23.8	330 270	23.9
130	23.8	340 280	24.0
140	23.8	350 290	24.0
150	23.8	360 300	24.0
160	23.7	370	
170	23.8	380	24.1
180	23.8	390	24.1
190	23.8	400	
200	23.8	410	
210	23.8	420	
220	23.8	430	
230	23.8	440	
240	23.8	450	
250	23.8	460	
260	23.8	470	
270	23.9	480	
280		490	
290		500	
300		510	
310		520	
320		530	
330		540	
340		550	
350		560	
360		570	
370		580	
380		590	
390		600	
400		610	
410		620	
420		630	
430		640	
440		650	
450		660	
460		670	
470		680	
480		690	
490		700	
500		710	
510		720	
520		730	
530		740	
540		750	
550		760	
560		770	
570		780	
580		790	
590		800	
600		810	
610		820	
620		830	
630		840	
640		850	
650		860	
660		870	
670		880	
680		890	
690		900	
700		910	
710		920	
720		930	
730		940	
740		950	
750		960	
760		970	
770		980	
780		990	
790		1000	
800		1010	
810		1020	
820		1030	
830		1040	
840		1050	
850		1060	
860		1070	
870		1080	
880		1090	
890		1100	
900		1110	
910		1120	
920		1130	
930		1140	
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950		1160	
960		1170	
970		1180	
980		1190	
990		1200	
1000		1210	
1010		1220	
1020		1230	
1030		1240	
1040		1250	
1050		1260	
1060		1270	
1070		1280	
1080		1290	
1090		1300	
1100		1310	
1110		1320	
1120		1330	
1130		1340	
1140		1350	
1150		1360	
1160		1370	
1170		1380	
1180		1390	
1190		1400	
1200		1410	
1210		1420	
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1250		1460	
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1270		1480	
1280		1490	
1290		1500	
1300		1510	
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1390		1600	
1400		1610	
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1480		1690	
1490		1700	
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1510		1720	
1520		1730	
1530		1740	
1540		1750	
1550		1760	
1560		1770	
1570		1780	
1580		1790	
1590		1800	
1600		1810	
1610		1820	
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1630		1840	
1640		1850	
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1680		1890	
1690		1900	
1700		1910	
1710		1920	
1720		1930	
1730		1940	
1740		1950	
1750		1960	
1760		1970	
1770		1980	
1780		1990	
1790		2000	
1800		2010	
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1830		2040	
1840		2050	
1850		2060	
1860		2070	
1870		2080	
1880		2090	
1890		2100	
1900		2110	
1910		2120	
1920		2130	
1930		2140	
1940		2150	
1950		2160	
1960		2170	
1970		2180	
1980		2190	
1990		2200	
2000		2210	
2010		2220	
2020		2230	
2030		2240	
2040		2250	
2050		2260	
2060		2270	
2070		2280	
2080		2290	
2090		2300	
2100		2310	
2110		2320	
2120		2330	
2130		2340	
2140		2350	
2150		2360	
2160		2370	
2170		2380	
2180		2390	
2190		2400	
2200		2410	
2210		2420	
2220		2430	
2230		2440	
2240		2450	
2250		2460	
2260		2470	
2270		2480	
2280		2490	
2290		2500	
2300		2510	
2310		2520	
2320		2530	
2330		2540	
2340		2550	
2350		2560	
2360		2570	
2370		2580	
2380		2590	
2390		2600	
2400		2610	
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2440		2650	
2450		2660	
2460		2670	
2470		2680	
2480		2690	
2490		2700	
2500		2710	
2510		2720	
2520		2730	
2530		2740	
2540		2750	
2550		2760	
2560		2770	
2570		2780	
2580		2790	
2590		2800	
2600		2810	
2610		2820	
2620		2830	
2630		2840	
2640		2850	
2650		2860	
2660		2870	
2670		2880	
2680		2890	
2690		2900	
2700		2910	
2710		2920	
2720		2930	
2730		2940	
2740		2950	
2750		2960	
2760		2970	
2770		2980	
2780		2990	
2790		3000	
2800		3010	
2810		3020	
2820		3030	
2830		3040	
2840		3050	
2850		3060	
2860		3070	
2870		3080	
2880		3090	
2890		3100	
2900		3110	
2910		3120	
2920		3130	
2930		3140	
2940		3150	
2950		3160	
2960		3170	
2970		3180	
2980		3190	
2990		3200	
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3010		3220	
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3040		3250	
3050		3260	
3060		3270	
3070		3280	
3080		3290	
3090		3300	
3100		3310	
3110		3320	
3120		3330	
3130		3340	
3140		3350	
3150		3360	
3160		3370	
3170		3380	
3180		3390	
3190		3400	
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3250		3460	
3260		3470	
3270		3480	
3280		3490	
3290		3500	
3300		3510	
3310		3520	
3320		3530	
3330		3540	
3340		3550	
3350		3560	
3360		3570	
3370		3580	
3380		3590	
3390		3600	
3400		3610	
3410		3620	
3420		3630	
3430		3640	
3440		3650	
3450		3660	
3460		3670	
3470		3680	
3480		3690	
3490		3700	
3500		3710	
3510		3720	
3520		3730	
3530		3740	
3540		3750	
3550		3760	
3560		3770	
3570		3780	
3580		3790	
359			

EXP: 04

EXP: CALORIMETRIC DETERMINATION OF HEAT OF DISSOLUTION REACTIONS

Name: Swapnil Das ID: 2405016

Data Table: Observation of temperature over time intervals

Mass of NaNO_3 - 1.0 gm		Mass of NaNO_3 - 1.0 gm	
Time (s)	Temp ($^{\circ}\text{C}$)	Time (s)	Temp ($^{\circ}\text{C}$)
0	24.2 24.5	170	23.9
20	24.2 24.6	180	23.9
40	24.1 24.6	190	23.8
60	24.5	200	23.8
80	24.5	210	23.7
90	24.4	$\Delta T = 0.9$	220
100	24.2		230
110	24.1		240
120	24.0		250
130	24.0		260
140	24.0	from graph 26.0 ± 26	270
150	24.0	26.0 ± 26	280
160	24.0		290

Expt no - 9

Expt name: CALORIMETRIC DETERMINATION OF
HEAT OF DISSOCIATION REACTION

Name: Md. Sifat Mondal

ID: 2405008

Section: A₁

Dept: CSE

Table: Observation of temperature over time interval

Mass of NaNO ₃ (1.5 gm)	Time (s)	Temp (°C)	Mass of NaNO ₃ (1.5 gm)	Time (s)	Temp (°C)
	0	23.3		190	23.3
	20	24.4		200	23.3
	40	24.5		210	23.2
	60	24.5		220	23.2
	80	24.5		230	23.2
	90	24.5		240	23.1
	100	24.4		250	23.1
	110	24.3		260	23.1
	120	24.1		270	23.1
	130	23.8		280	23.1
	140	23.8	ΔT = 1.4	290	23.1
	150	23.6			
	160	23.6			
	170	23.5			

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Date : 26.01.26

Roll : 2405009

Exp. Name : Calorimetric determination of heat of dissolution reactions (heats of dissociation)

Data table: Observation of temperature over time intervals

① Mass of NaNO_3 - 2.0 gm
Mass of MgSO_4 - 0.5 gm

Time (s)	Temp ($^{\circ}\text{C}$)
0	22.5 22.8
20	23.4 24.1
40	23.4 24.3
60	23.4 24.5
80	23.4 24.5
90	23.3 24.3
100	23.1 23.5
110	23.1 23.3
120	23.0 23.1
130	22.9 22.8
140	22.8 22.6
150	22.8 22.3
160	22.6 22.3
170	22.6 22.1
180	22.1 22.5
190	22.1 22.0
200	22.1 22.1
210	22.1

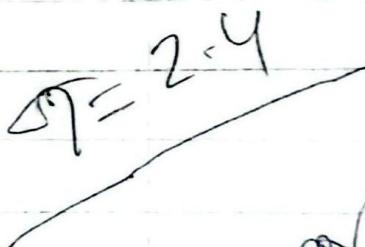
② Mass of NaNO_3 - 2.0 gm

Time (s) Temp ($^{\circ}\text{C}$)

220 22.6

230 22.6

240 22.6



$\Delta T = 2.4$
for MgSO_4
26.01.26

