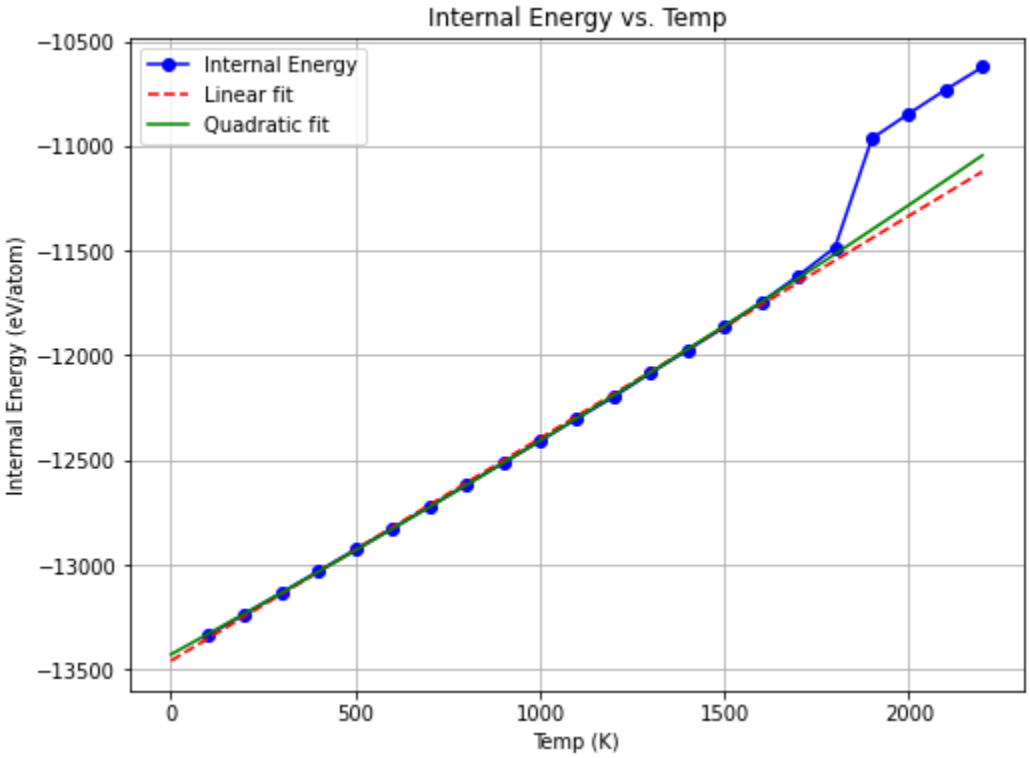
Chase Katz
MSEN 470
HW1

Part A:

1. System melts in between 1800K and 1900K



Temp: 100	Energy: -13337.276019149562	Error:+- 0.9613963962537726
Temp: 200	Energy: -13235.129795193403	Error:+- 1.9510733868726584
Temp: 300	Energy: -13133.453683546331	Error:+- 2.6669089285451673
Temp: 400	Energy: -13030.717522682027	Error:+- 3.5915377964723874
Temp: 500	Energy: -12928.089860298885	Error:+- 4.900984170244693
Temp: 600	Energy: -12826.11009245975	Error:+- 5.493336768750357
Temp: 700	Energy: -12723.266338081201	Error:+- 6.718108582776355
Temp: 800	Energy: -12618.48490138141	Error:+- 7.4722381397509015
Temp: 900	Energy: -12514.17918675647	Error:+- 8.428161161279496
Temp: 1000	Energy: -12410.144630127897	Error:+- 9.185775328682269
Temp: 1100	Energy: -12302.621100610068	Error:+- 10.999518315431517
Temp: 1200	Energy: -12198.792594849803	Error:+- 11.355785732108842
Temp: 1300	Energy: -12084.51817959654	Error:+- 12.750125831697765
Temp: 1400	Energy: -11976.350212556279	Error:+- 13.988899936156997
Temp: 1500	Energy: -11865.272941426045	Error:+- 15.192873136337397
Temp: 1600	Energy: -11746.816472411801	Error:+- 15.812303779607618
Temp: 1700	Energy: -11620.562120234705	Error:+- 16.126892733477312

Temp: 1800	Energy: -11484.69296639065	Error:+- 21.714002354315294
Temp: 1900	Energy: -10964.494336230653	Error:+- 19.949381046164717
Temp: 2000	Energy: -10846.188486643496	Error:+- 20.643296338302882
Temp: 2100	Energy: -10731.587668627537	Error:+- 21.389865058763544
Temp: 2200	Energy: -10623.508216222863	Error:+- 21.443442219595283

2. Constant Volume Heat Capacity: 1.0622229268621508 eV/K

   The linear line of regression is y = 1.0622229268621508 x + -13459.046848961949

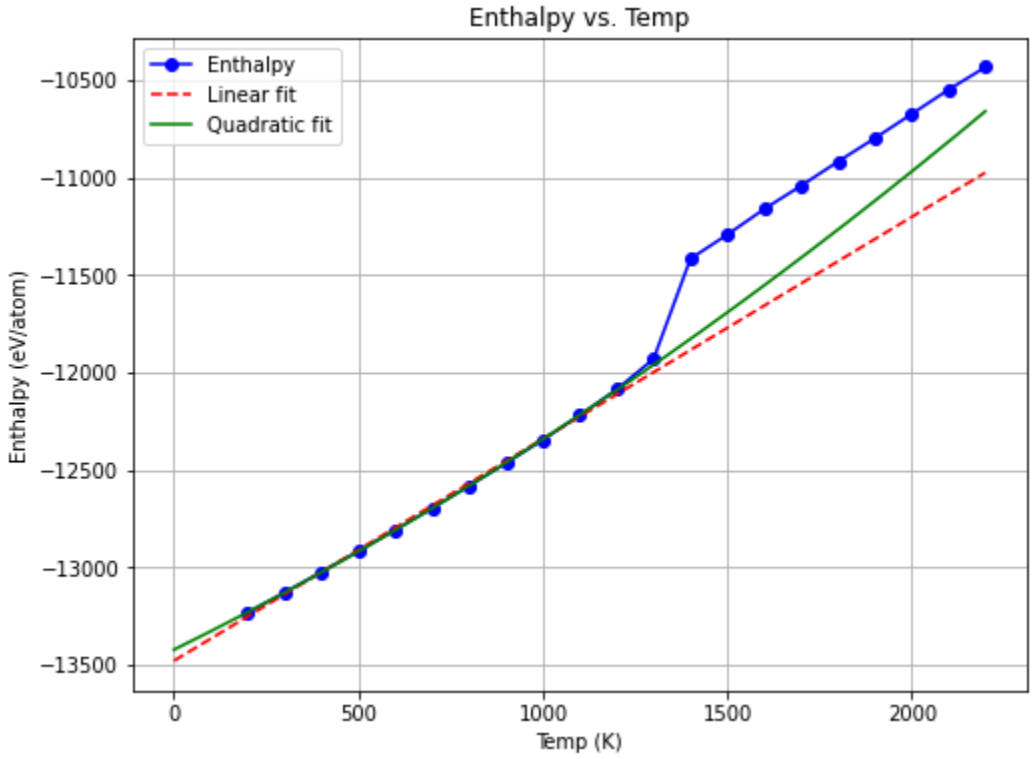
   R^2 value for linear fit: 0.9988605904457946

3. The quadratic line of regression is y = 5.3366403626054546e-05 x^2 + 0.9661634003352525 x + -13428.627998895097

   R^2 value for quadratic fit: 0.9997600629167863

Part B:

1. System melts between 1300K and 1400K



Temp: 200	Energy: -13233.965586683535	Error:+- 23.003463754550115
Temp: 300	Energy: -13130.533774492998	Error:+- 33.248644220783746
Temp: 400	Energy: -13024.489587957	Error:+- 35.78530366406764

Temp: 500	Energy: -12918.53980140289	Error:+- 36.76562440926902
Temp: 600	Energy: -12808.608024053	Error:+- 42.09321002639402
Temp: 700	Energy: -12698.506833750944	Error:+- 47.10249148498896
Temp: 800	Energy: -12582.95873769837	Error:+- 49.068478815706456
Temp: 900	Energy: -12467.195799228988	Error:+- 46.81807602472612
Temp: 1000	Energy: -12346.984545212326	Error:+- 55.57145103079081
Temp: 1100	Energy: -12220.762813503352	Error:+- 54.41426166467792
Temp: 1200	Energy: -12088.002379156747	Error:+- 57.12825290663391
Temp: 1300	Energy: -11932.204937975264	Error:+- 60.15819847489159
Temp: 1400	Energy: -11417.690307547566	Error:+- 57.35703733838222
Temp: 1500	Energy: -11294.033572949986	Error:+- 61.61864983747305
Temp: 1600	Energy: -11162.665210444171	Error:+- 61.830697743087526
Temp: 1700	Energy: -11043.061426885904	Error:+- 65.56739764533401
Temp: 1800	Energy: -10919.043962511883	Error:+- 65.9950560464264
Temp: 1900	Energy: -10799.142286908611	Error:+- 66.97746787821113
Temp: 2000	Energy: -10674.575516180455	Error:+- 70.69748363450046
Temp: 2100	Energy: -10549.68687630483	Error:+- 67.1391158317473
Temp: 2200	Energy: -10434.058311888626	Error:+- 69.88490100690206

2. Constant Pressure Heat Capacity: 1.1390683909571577 eV/K

   The linear line of regression is y = 1.1390683909571577 x + -13481.034044864566

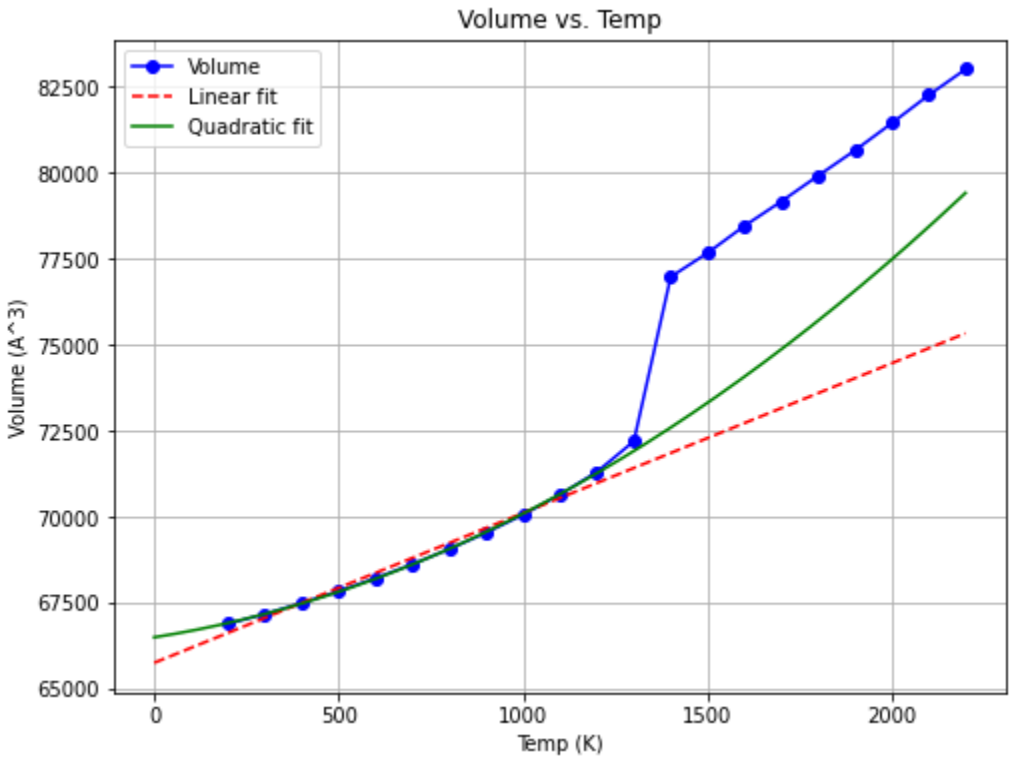
   R^2 value for linear fit: 0.9967235178313387

3. The quadratic line of regression is y = 0.00014659183154461093 x^2 + 0.9338398267947023 x + -13423.863230562169

   R^2 value for quadratic fit: 0.9995209444061448

Part C:

1.



Temp: 200	Volume: 66885.3784732656	Error:+- 45.35094533429277
Temp: 300	Volume: 67170.29385052035	Error:+- 65.44217550806198
Temp: 400	Volume: 67488.75810958803	Error:+- 71.24951501075465
Temp: 500	Volume: 67833.67043800424	Error:+- 74.63639504685295
Temp: 600	Volume: 68211.49853915069	Error:+- 87.10888347044916
Temp: 700	Volume: 68615.02916346725	Error:+- 99.4570084880687
Temp: 800	Volume: 69058.71732447995	Error:+- 107.13566231277018
Temp: 900	Volume: 69533.23196060899	Error:+- 107.99332891303169
Temp: 1000	Volume: 70055.81175011791	Error:+- 130.38904909912785
Temp: 1100	Volume: 70639.8755750573	Error:+- 135.03165584921067
Temp: 1200	Volume: 71299.2331044901	Error:+- 151.45235422276113
Temp: 1300	Volume: 72189.11564765907	Error:+- 176.2514749747938
Temp: 1400	Volume: 76966.90579409273	Error:+- 191.46142960802774
Temp: 1500	Volume: 77661.89426200728	Error:+- 215.67103733941
Temp: 1600	Volume: 78448.78114865281	Error:+- 221.76940537701861
Temp: 1700	Volume: 79160.42234816322	Error:+- 240.72235258111948
Temp: 1800	Volume: 79908.34106483178	Error:+- 249.9623289007552
Temp: 1900	Volume: 80645.49808074272	Error:+- 265.4731058636088
Temp: 2000	Volume: 81438.65876559165	Error:+- 283.786433170245
Temp: 2100	Volume: 82252.84053859436	Error:+- 288.6662243702069
Temp: 2200	Volume: 83005.12590818817	Error:+- 309.2886088287407

The linear line of regression is y = 4.35410025512717 x + 65751.35693857011

R^2 value for linear fit: 0.9718696153437777

The quadratic line of regression is y = 0.0018999966854392639 x^2 + 1.6941048955122007 x + 66492.35564589142

R^2 value for quadratic fit: 0.9973995498890993

2. Linear difference between 300K and 600K: -9.894633236405217e-07
   Quadratic difference between 300K and 600K: 1.606864958985905e-05

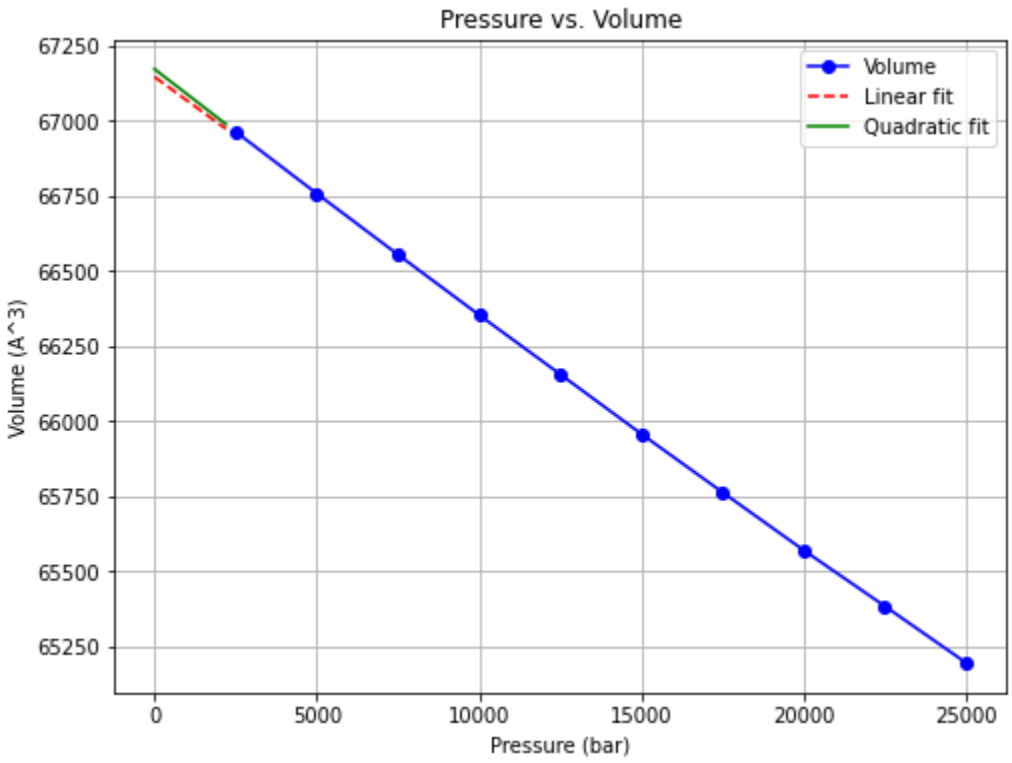
   Linear:
Temp: 200	Volumetric Thermal Expansion Coeff: 6.509793851084395e-05
Temp: 300	Volumetric Thermal Expansion Coeff: 6.4821813416757e-05
Temp: 400	Volumetric Thermal Expansion Coeff: 6.451593386941564e-05
Temp: 500	Volumetric Thermal Expansion Coeff: 6.41878911610208e-05
Temp: 600	Volumetric Thermal Expansion Coeff: 6.383235009311648e-05
Temp: 700	Volumetric Thermal Expansion Coeff: 6.345694679738513e-05
Temp: 800	Volumetric Thermal Expansion Coeff: 6.304924886845136e-05
Temp: 900	Volumetric Thermal Expansion Coeff: 6.261898278500552e-05
Temp: 1000	Volumetric Thermal Expansion Coeff: 6.215187785786868e-05
Temp: 1100	Volumetric Thermal Expansion Coeff: 6.163799440021363e-05
Temp: 1200	Volumetric Thermal Expansion Coeff: 6.106798159730794e-05
Temp: 1300	Volumetric Thermal Expansion Coeff: 6.0315190400429345e-05
Temp: 1400	Volumetric Thermal Expansion Coeff: 5.6571070516665496e-05
Temp: 1500	Volumetric Thermal Expansion Coeff: 5.6064821705710375e-05
Temp: 1600	Volumetric Thermal Expansion Coeff: 5.550245894676902e-05
Temp: 1700	Volumetric Thermal Expansion Coeff: 5.500349955154325e-05
Temp: 1800	Volumetric Thermal Expansion Coeff: 5.448868287222446e-05
Temp: 1900	Volumetric Thermal Expansion Coeff: 5.399061768789401e-05
Temp: 2000	Volumetric Thermal Expansion Coeff: 5.346478344713119e-05
Temp: 2100	Volumetric Thermal Expansion Coeff: 5.293556096806354e-05
Temp: 2200	Volumetric Thermal Expansion Coeff: 5.2455799656797496e-05

   Quadratic:
Temp: 200	Volumetric Thermal Expansion Coeff: 3.669118162602343e-05
Temp: 300	Volumetric Thermal Expansion Coeff: 4.219280197110235e-05
Temp: 400	Volumetric Thermal Expansion Coeff: 4.76242611939097e-05
Temp: 500	Volumetric Thermal Expansion Coeff: 5.2984035181116293e-05
Temp: 600	Volumetric Thermal Expansion Coeff: 5.8261451560961403e-05
Temp: 700	Volumetric Thermal Expansion Coeff: 6.345694679738513e-05

Temp: 800	Volumetric Thermal Expansion Coeff: 6.855180309780931e-05
Temp: 900	Volumetric Thermal Expansion Coeff: 7.354898924013837e-05
Temp: 1000	Volumetric Thermal Expansion Coeff: 7.842458932583108e-05
Temp: 1100	Volumetric Thermal Expansion Coeff: 8.315554855751621e-05
Temp: 1200	Volumetric Thermal Expansion Coeff: 8.771618807457524e-05
Temp: 1300	Volumetric Thermal Expansion Coeff: 9.18988440034923e-05
Temp: 1400	Volumetric Thermal Expansion Coeff: 9.113131861512973e-05
Temp: 1500	Volumetric Thermal Expansion Coeff: 9.520878961417805e-05
Temp: 1600	Volumetric Thermal Expansion Coeff: 9.909770649191723e-05
Temp: 1700	Volumetric Thermal Expansion Coeff: 0.00010300720213621875
Temp: 1800	Volumetric Thermal Expansion Coeff: 0.00010679852502718849
Temp: 1900	Volumetric Thermal Expansion Coeff: 0.0001105342829088434
Temp: 2000	Volumetric Thermal Expansion Coeff: 0.000114123829863417
Temp: 2100	Volumetric Thermal Expansion Coeff: 0.00011761406549622891
Temp: 2200	Volumetric Thermal Expansion Coeff: 0.00012112613771064901

Part D:

1.



Pressure: 2500	Volume: 66962.05631229235	Error:+- 61.62215224800108
Pressure: 5000	Volume: 66756.40038346821	Error:+- 64.56236330652268
Pressure: 7500	Volume: 66553.49076585975	Error:+- 45.27014302849736
Pressure: 10000	Volume: 66352.74872379827	Error:+- 58.6955268023886
Pressure: 12500	Volume: 66155.31048010028	Error:+- 60.75948718891041

Pressure: 15000	Volume: 65956.83165583144	Error:+- 60.323752314302354
Pressure: 17500	Volume: 65762.88512345821	Error:+- 58.69931938885659
Pressure: 20000	Volume: 65570.15376717702	Error:+- 48.982643568561194
Pressure: 22500	Volume: 65384.18826589794	Error:+- 55.920266871137656
Pressure: 25000	Volume: 65196.13759782852	Error:+- 54.60415864491204

2. Linear average Isothermal compressibility: 1.1883062059662485e-06 bar^-1
   Quadratic average Isothermal compressibility: 1.2651082592005392e-06 bar^-1

   The linear line of regression is y = -0.07850547362877308 x + 67144.47056996683

   R^2 value for linear fit: 0.9997662967183794

   The quadratic line of regression is y = 1.8862190359057982e-07 x^2 +
   -0.08369257597751402 x + 67170.40608171053

   R^2 value for quadratic fit: 0.9999971536155575

   Linear:
Pressure: 2500	Isothermal compressibility: 1.1723874377848472e-06
Pressure: 5000	Isothermal compressibility: 1.1759992027403332e-06
Pressure: 7500	Isothermal compressibility: 1.179584612698398e-06
Pressure: 10000	Isothermal compressibility: 1.1831533001829671e-06
Pressure: 12500	Isothermal compressibility: 1.1866843804230617e-06
Pressure: 15000	Isothermal compressibility: 1.190255378524268e-06
Pressure: 17500	Isothermal compressibility: 1.1937656549190765e-06
Pressure: 20000	Isothermal compressibility: 1.1972745085748328e-06
Pressure: 22500	Isothermal compressibility: 1.2006797929419082e-06
Pressure: 25000	Isothermal compressibility: 1.2041430140086681e-06

   Quadratic:
Pressure: 2500	Isothermal compressibility: 1.2357665074328167e-06
Pressure: 5000	Isothermal compressibility: 1.2254458968981052e-06
Pressure: 7500	Isothermal compressibility: 1.2150113614346448e-06
Pressure: 10000	Isothermal compressibility: 1.2044736569750882e-06
Pressure: 12500	Isothermal compressibility: 1.1938123759770737e-06
Pressure: 15000	Isothermal compressibility: 1.1831059332410704e-06
Pressure: 17500	Isothermal compressibility: 1.1722540640837053e-06
Pressure: 20000	Isothermal compressibility: 1.1613164749357152e-06
Pressure: 22500	Isothermal compressibility: 1.1501953654315222e-06
Pressure: 25000	Isothermal compressibility: 1.1390472431983217e-06