Vapor pressure and enthalpy of vaporization of water

Vapor Pressure and Enthalpy of Vaporization of Water 1/9/12 Emily Toy Lab Partner: Zack Ronnei Instructor: Ms. Olsen, AP Chemistry Purpose: The purpose of this lab is to find the vapor pressure of water at temperatures between 50oC and 80oC. Procedure: 1. Take a10 mL graduated cylinder and fill it with 7 mL of water. 2. Next fill a 1000 mL beaker ? full with water. 3. Cover the graduated cylinder by putting your finger on top and place the cylinder in the 1000 mL beaker. Make sure the graduated cylinder is under the surface of the water. . Measure the difference between the height of the water in the graduated cylinder and the height of the water in the beaker. 5. Record the barometric pressure. 6. Heat the beaker until the water is about 80oC and record the temperature and the volume. 7. Cool the beaker until the temperature reaches 50oC recording the temperature and volume every 5oC. 8. When the beaker reaches 50oC add ice to cool it to 0oC. Record the gas volume and temperature. Observations: | Atmospheric Pressure | 770. mmHg | | Height of Water above Gas | 50 mmH2O | | Temperature (oC) | Volume (mL) | | 80 | 103 | | 75 | 100 | | 70 | 95 | | 65 | 92 | | Temperature (oC) | Volume (mL) | 60 | 83 | | 55 | 75 | | 50 | 62 | | 3 | 12. 5 | Analysis: 1. | Temperature (oC) | Volume (mL) | Adjusted Volume (mL) | | 80 | 103 | 102. 8 | | 75 | 100 | 99. 8 | | 70 | 95 | 94. | | 65 | 92 | 91. 8 | | Temperature (oC) | Volume (mL) | Adjusted Volume (mL) | | 60 | 83 | 82. 8 | | 55 | 75 | 74. 8 | | 50 | 62 | 61. 8 | | 3 | 12. 5 | 12. 3 | 2.

The total pressure in the cylinder is: [(50 mmH2O) (1. 00 mmHg/13. 6 mmH2O)] + 770. 5 mmHg = 774. 176 mmHg 3. The number of moles of air in the graduated cylinder at 0oC is: (774. 176)(0. 0125) / (62. 4) (273. 15) = 5. 6776 x 10-4 moles 4. List of all calculations for each temperature and the

adjusted volume using the number of moles calculated in #3. 80oC : P= [5. 6776x10-4(62. 4)(353. 15)] / (0. 1028) = 121. 7 mmHg 75oC : P= [5. 6776x10-4(62. 4)(348. 15)] / (0. 0998) = 123. 6 mmHg 70oC : P= [5. 6776x10-4(62. 4)(343. 15)] / (0. 0948) = 128. 2 mmHg 65oC : P= [5. 6776x10-4(62. 4)(338. 15)] / (0. 0918) = 130. 5 mmHg 60oC : P= [5. 776x10-4(62. 4)(333. 15)] / (0. 0828) = 142. 5 mmHg 55oC : P= [5. 6776x10-4(62. 4)(328. 15)] / (0. 0748) = 155. 4 mmHg 50oC : P= [5. 6776x10-4(62. 4)(323. 15)] / (0. 0618) = 185. 3 mmHg | Temperature (oC) | Partial Pressure of Air (mmHg) | | 80 | 121. 7 | | 75 | 123. 6 | | 70 | 128. 2 | | 65 | 130. 5 | | Temperature (oC) | Partial Pressure of Air (mmHg) | | 60 | 142. | | 55 | 155. 4 | | 50 | 185. 3 | | 3 | 809. 2 | | Temperature (oC) | Partial Pressure of H2O (mmHg) | | 60 | 631. 66 | | 55 | 618. 76 | | 50 | 588. 86 | | | | 5. Table of vapor pressure of water at each temperature.

Ex: 774. 16-121. 7= 652. 46 | Temperature (oC) | Partial Pressure of H2O (mmHg) | | 80 | 652. 46 | | 75 | 650. 56 | | 70 | 645. 96 | | 65 | 643. 66 | 6. Graph on other page. The ? Hvap is 8595. 7*8. 314= 7143. 267 J/mol= 71 . 43kJ/mol. Evaluation: 1. [(71. 43-40. 65) / 40. 65] x 100% = 75. 7% 2. Hexane has a lower enthalpy of vaporization than water. It requires less energy to be vaporized.

When hexane is heated it has more vapor. Sources of Error: 1. The air in the graduated cylinder could have escaped because of the space between the graduated cylinder and the beaker. This would affect the volume measurements and cause the adjusted volume and the partial pressure of air and partial pressure of water to be lower than it should be. Therefore, the enthalpy of vaporization of water will be t00 low. 2. We didn’t have time to

put ice in our beaker to record the temperature and volume, which is a major source of error because we had to use somebody else’s data.

This is not accurate because everything was different from ours. Like the amount of water in the beaker in the first place and the amount of gas in every temperature interval. Our data could be too high or too low now causing the overall equation for slope to be wrong resulting in the enthalpy of vaporization to be off. 3. Another source of error is that there were bubbles of water stuck to the side of the graduated cylinder as it was upside down in the beaker. This would make the volume of gas to be too high because it isn’t all air that is in the cylinder.

The volume being too high would make the adjusted volume, pressure of the cylinder, partial pressure of the air and water to be too high also. If these are all too high then the equation for slope will be too high finally causing the enthalpy of vaporization to be too high. Conclusion: 1. I learned that air expands as it is heated and becomes saturated with water vapor. As it cools the volume of air contracts and there becomes less water vapor. I also learned how to find the vapor pressure of water and how to use the slope of a graph to solve a problem. I also learned that accurate information is very crucial in experiments like this.