Vapor pressure and enthalpy of vaporization of water lab answers

When a sample of liquid is introduced into a container, the molecules tend to escape from the confinement of the liquid state into the gaseous state in a process called evaporation. Eventually, the vaporization rate and the condensation rate will become equal, and the pressure in the container will level off to some constant value. The system is said to be in equilibrium, and the pressure of the gas that exists on the liquid is called vapour pressure. The higher the vapour pressure, the more volatile the liquid. In addition, vaporization is an endothermic process, as energy is needed to overcome the attraction that a liquid molecule feels for its neighbors. The energy needed to evaporate a mole of a substance at constant temperature and pressure is called the molar enthalpy of vaporization, âΔHvap. Its magnitude is a measure of the strengths of the intermolecular forces in a pure substance. The mathematical relationship between the vapour pressure and the enthalpy of vaporization of a pure liquid is summarized by the Clausius-Clapeyron equation. The ratio can be written simply as: ln P = – ÎHvap/ (RT) + C where ÎHvap is the enthalpy of the vaporization of the liquid, P is the vapor pressure, T is the temperature, R is the universal gas constant and C is a constant to be evaluated experimentally. Several assumptions are involved in the derivation of this equation, the main ones being that the molar volume of liquid water is considered much smaller than the molar volume of water vapour and that water vapour is an ideal gas. Based on the first equation, we can see that this equation fits a straight line y = mx + b where y = lnP, x=1/T and slope, m = – =Hvap/R. If a graph is made of ln P vs 1/t, the heat of the vaporization can be calculated from the slope of the line. Therefore, the main purpose of this experiment is to calculate the enthalpy of water vaporization by obtaining the pressure of water vapour over a range of temperatures by applying the Clausius-Clapeyron equation. In an inverted 10mL graduated cylinder, an air sample is trapped. The cylinder is submerged in a handkerchief of water. The beaker is heated to 80oC and the air volume is measured. While mixing the water in the beaker to be sure of even heat distribution, the water is cooled and the gas volume is recorded every 5oC. After the beaker temperature reaches 50oC, the beaker is further cooled to 0oC almost adding ice. The air volume and the near-zero temperature are measured. The graduated cylinders are designed to measure volume in a vertical position. Since the volume is measured in an inverted position, there will be a slight error, since the meniscus of the water is also inverted. To account for this error, 0.20 mL is subtracted from each measurement to give the correct volume. 1. Measured volume and correct volume of air vapour mixture at different temperatures. Temperature (oC) Volume (mL 857.10 806.40 755.30 704.90 704.90 602.80 552.30 502.20 Supposing that a negligible amount of water vapour is present below 273 K and the air behaves ideally, reading the volume