How temperature affects reaction rate

Lab Report: How Temperature affects Reaction Rate Aim: The Aim is to investigate how temperature can affect Reaction Rate. The experiment will be performed by heating equally sized and weighted lime stones with equal amounts and concentration of Hydrochloric acid at different temperatures. The temperatures will be 35˚C and 40˚C. We will measure the reaction rates by observing gas release of the reaction between lime stones and Hydrochloric acid. The amount of gas release at different temperatures will be compared afterwards to see if temperature can affect Reaction Rate. Hypothesis: I predict that the higher the temperature, the higher the Reaction Rate will be. Therefore I predict that the Reaction rate of the 40˚ C heated Lime Stones and HCL acid will be higher than the 35˚ C heated Lime Stones and HCL acid. I predict this because I know that when the temperature is raised, particles move faster and collide more frequently. Therefore if temperature is raised, the Reaction rate will increase. The increase in temperature will allow Reaction rate to rise and also increase amount of molecules being thermally activated (give enough energy to collide). I also predict that Reaction rate will increase roughly by a double for each 10˚ C. In this case, I suppose the Reaction rate will increase roughly by a half for 5˚C increased temperature. Variables: The independent variable is the one that is changed by the scientist: ✦ Temperature in ˚C, at which the HCl acid and Lime Stones will be heated The dependent variable changes in response to the change the scientist makes to the independent variable: ✦ Rate of Reaction, measured by observing how much gas (in cm^3) is produced ✦ Amount of molecules activated (given enough energy to collide) ✦ How fast the particles move ✦ How energetic the molecules will collide The controlled variables are quantities that a scientist wants to remain constant:

✦ Size of Lime Stones ✦ Amount of Lime Stones ✦ Amount of Hydrochloric Acid ✦ Concentration of Hydrochloric Acid Apparatus: ✦ Tripod ✦ Gauze ✦ Bunsen Burner ✦ 2x Flasks (100 cm^3) ✦ Delivery Tube ✦ Stand and Clamp ✦ Gas Syringe (100 cm^3) ✦ 2x 20g Lime stones (small pieces) ✦ 2x 20cm^3 of 0. 2M Hydrochloric Acid (HCl) ✦ Thermometer (capable to measure until 100˚ C) ✦ Stop watch ✦ Access to balance ✦ Eye Protection ✦ Bung Diagram: Method: 1. Collect the apparatus, as listed in the ‘ Apparatus' list 2. Set up Apparatus as shown in the diagram. The Apparatus should be set up without the bung, delivery tube and the gas syringe at first as they are not required until later on in the experiment. 3. Heat the flask with 20 cm^3 Hydrochloric acid until it reaches the temperature of 35˚C 4. Turn off heat immediately and take the thermometer out of the flask 5. Place the 20g of Lime Stone in the flask and immediately block the top of the flask with bung. The bung must be connected to the delivery tube, which will be connected to the Gas Syringe (as shown in diagram). 6. Record the results/Reaction Rate by observing the amount of gas produced each 15 seconds (in regular intervals). 7. Keep recording until no more reaction can be seen. 8. Repeat procedures 1 to 7 with the temperature of 40˚C and a new/another set of lime stones and hydrochloric acid 9. compare results to see whether temperature affects reaction rate. Data/Results: Table showing the reactions rates of HCl acid and lime stones heated at 35˚C and 40˚C Time in Seconds Reaction Rates (in cm^3) at temperature of 35˚C Reaction Rates (in cm^3) at temperature of 40˚C 0 0 0 15 10 12 30 15 21 45 18 24 60 20 27 75 21 30 90 22 31 105 22 32 120 22 33 135 22 33 150 22 33 165 22 33 180 22 33 Graph: Conclusion: My Results met my predictions in the hypothesis. As predicted, the HCl acid and lime stones heated at 40˚C reacted faster than

the HCl acid and lime stones heated at 35˚C. Raising the temperature increased the amount of kinetic energy in reactant molecules to allow the particles to move faster and collide more frequently and energetically. There is a higher percentage of reaction between molecules when collision speed and energy is increased. Therefore increasing the temperature also increased the Reaction Rate. The increased temperature also generated speed which allowed the molecules to be activated faster. This allowed the molecules the react fast from the beginning onwards, which can be seen on the graph. Also, the reaction rate increased roughly by a half when heated with 5˚C higher temperature. This can be seen clearly in the end result, where the Reaction rate of the 35˚C heated HCl and Lime stones increased (interestingly and exactly) by a half when heated at 40˚C (22 cm^3 x 1. 5 = 33 cm^3). Evaluation: As the experiment had to be done in a scientific and a very careful manner, it was difficult to achieve optimal/precise results. Our group had some cooperative problems, which caused us to repeat the experiment multiple times. Commitment was necessary to achieve precise results. As the Hydrochloric Acid didn't maintain an equal temperature throughout the procedure (after turning off heat), the results may have been affected slightly. The experiment was interesting but the results were too predictable because it was obvious that the outcome of higher temperature would be a higher reaction rate. Investigating with other factors to increase reaction rates would've been more interesting. For example, it would've been interesting to experiment with various catalysts. Also, I would have preferred more advanced apparatus, for example, a digital thermometer.