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Chemistry 12 Lab Investigation:

Factors which *Affect* Reaction Rate

**Name: Block:**

**Group Members: Due Date:**

**Objective:** *To conduct a series of experiments which test factors affecting the rate of a chemical reaction. Through this investigation you will analyse factors such as: surface area, temperature, concentration and presence of a catalyst. Research, data & results will be presented as a* ***formal lab report****.*

**Task Outline & What to Hand In:**

* Pre-lab flow chart completed individually by each group member ***before the lab!***
* Data & results to be completed on attached pages *(as a group)*
* Reaction Rate calculations on a separate page *(individual)*
* Each group member is to complete their own Analysis & discussion *(~1 paragraph per experiment)*
* Evaluation ~1-2 paragraphs *(individual)*
* Conclusion ~1paragraph which answers the aim of the experiment
* Presentation *(cover page included, word processed, calculations may be hand written neatly with correct significant figures, includes appropriate section headings, completed in order)*
* Safety *(this mark will be given by teacher during the lab)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Criteria** | **Excellent** | **Good** | **Satisfactory** | **Needs Improvement** | **Poor/Not shown**  | **Student Self Evaluation** | **Teacher Assessment** |
| **5** | **4** | **3** | **2** | **1** |
| **Aim, Background *(and Hypothesis & Variables where applicable)***Clearly states the aim of the experiment and briefly outlines the related theory  | **n/a** | **n/a** |
| **Data, Results & Calculations:** *(hand written neatly)*Provides results/observations (and diagrams where appropriate) that are presented in correctly annotated tables and/or graphs  |  |  |
| **Analysis & Discussion:** *(word processed)*Correctly identifies and explains the theory relating to the experiment and supports this with accurate observations  |  |  |
| **Evaluation:** *(word processed)*Identifies and defines the appropriateness of the experimental method (and presents a model for future experimental investigations where appropriate)  |  |  |
| **Conclusion:** *(word processed)*Identifies and defines important concepts and principles relevant to the experiment by relating back to the aim and hypothesis. |  |  |
| **Presentation:**Practical report is presented in the correct format, is written fluently and provides appropriate and accurate referencing |  |  |
| **Safety:**Demonstrates an organized and safe approach to experimental work |  |  |
| **Results Summary** | **/30** | **/30** |

**Part A: Effect of Surface Area on Reaction Rate**

**Aim:** To determine the effect of the size of pieces (marble chips, or powder) on the rate of a chemical reaction.

**Materials:**

* 3g Calcium carbonate (marbles x2, powdered)
* 50mL Dilute hydrochloric acid (**1.5M**)
* 250mL beaker (x2)
* Stopwatch
* Balance/ weigh scale
* Measuring cylinder
* Paper plate
* Funnel
* Safety glasses
1. Identify the **independent and dependent variables** in this experiment **Fig 1. Experimental set-up**
	1. Independent variable
	2. Dependent variable
2. Write a **hypothesis** for the reaction between calcium carbonate and hydrochloric acid

If

**Method:**

* Identify the independent variables, and construct a hypothesis for the experiment **before you begin!**
* A paper plate, then a 250 mL beaker were placed on the electronic balance and the balance was zeroed (tare the scale).
* Using a measuring cylinder, 50mL of HCl was added to the beaker and the mass was recorded in your results table, and the beaker placed aside.
* In a separate beaker, Calcium carbonate (marble chips) were added to the beaker until the balance measured *close to 3 g*. Record this mass in your results table
* 50 mL of the hydrochloric acid was carefully poured into the beaker containing CaCO3 while it was still on the balance.
* Timing commenced as soon as the acid was added.
* The reading on the balance was recorded every 30 seconds **for 5 mins** and recorded in a table.
* ***This experiment was repeated for powdered calcium carbonate***
1. Write a *balanced chemical equation* to represent the reaction:

***Safety:*** *Acid hazard. Wear safety glasses. Wash hands with soap and water.*

**Observations & Notes:**

**Part B: Effect of Temperature on Reaction Rate**

**Aim:** To determine the effect of temperature on reaction rate

**Materials:**

* 1.0M HCl
* Mg ribbon (~1cm strip x3)
* Test tubes (x3)
* Test tube rack
* Stopwatch
* 250mL beaker (x3)
* 10mL measuring cylinders
* Safety glasses
* Kettle (for hot water)
* Thermometer
* Dropping pipette

**Method:**

* Identify the variables, and construct a hypothesis for the experiment (question #4-5)
* Prepare solutions: **10mL** of *hyrdochloric acid* **in 3 separate test tubes**, and **3 approx 1cm strips of *magnesium.*** Test tube rack should contain 3 labelled test tubes.
* Prepare water baths: cool, warm and hot as indicated below (3 separate 250mL beakers)

|  |  |  |  |
| --- | --- | --- | --- |
| **Water Bath Ratio** | **COOL** | **WARM** | **HOT** |
| **Tap water** | 200mL  | 100mL  | 50mL  |
| **Kettle water** | 0mL  | 100mL  | 150ml  |

* *As shown in the diagram to the right****🡪*** Place 1 test tube containing HCl into each water bath
* Allow the test tubes to remain in the water baths for 2min, prior to starting the experiment and *record the initial temperature* in results table 2.
* **Start timer!** *Carefully* drop Mg strip into HCl solution and leave the test tube containing the reaction mixture in the water bath while the reaction time is measured.
* **The reaction is finished when the magnesium strip disappears and no more hydrogen gas is produced.**

***Safety:*** *Acid hazard. Avoid contact. Wear safety glasses. Wash hands with soap and water.*

1. Identify **the independent and dependant variables** in this experiment
	1. Independent variable
	2. Dependent variable
2. Write a **hypothesis** for the reaction between magnesium and hydrochloric acid in this experiment.

If

1. Write a *balanced chemical equation* to represent the reaction:

**Observations & Notes:**

**Part C: Effect of Concentration on Reaction Rate**

**Aim:** To investigate the effect of concentration on reaction rate

**Materials:**

* 15mL x 0.5M HCl (hydrochloric acid)
* 15mL x 1.0M HCl
* 15mL x 3.0M HCl
* Distilled water
* Strips of magnesium (~2cm long)
* 4 test tubes
* Test tube rack
* 4 thermometers
* 10mL measuring cylinder
* Stopwatch
* Safety glasses

**Method:**

1. Set up test tubes *in a test tube rack*, numbered and containing **15mL** of various solutions as described in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Tube** | **1** | **2** | **3** | **4** |
| **15mL** | Distilled water | 0.5M HCl | 1.0M HCl | 3.0M HCl |

*The following steps are to be conducted for each test tube INDIVIDUALLY as you only have 1 thermometer. This means complete steps #2-5 for test tube 1, THEN test tube 2, THEN test tube 3….etc.*

1. Record the initial temperature of the solution (table 3)
2. **Start time!** Add the magnesium strips to the test tube
3. Continue to record temperature and time throughout the experiment ***to a max of 5min.***
4. Include qualitative and quantitative results & observation in table 3.

***Safety:*** *Acid hazard. Wear safety glasses. Wash hands with soap and water.*

1. Identify **the independent and dependent variables** in this experiment
	1. Independent variable
2. Dependent variable
3. In this experiment, hydrochloric acid reacts with magnesium metal. Write a **hypothesis** which reflects the aim of the experiment.

If

**Observations & Notes:**

**Part D: Effect of a Catalyst on Reaction Rate**

**Aim:** To investigate the effect of a catalyst on reaction rate

**Materials:**

* 30-40mL x 6% H2O2 (hydrogen peroxide)
* Manganese dioxide, MnO2 *(solid, powdered)*
* Distilled water
* 2 Erlenmeyer *(conical)* Flasks
* 2 x 50mL measuring cylinder
* Stopwatch
* Scale x 2
* Safety glasses

**Method:**

1. Place a measuring cylinder on a scale and tare the balance. Measure out **40mL** of hydrogen peroxide, and *record the initial mass of H2O2*. **Keep in the measuring cylinder** until start of reaction.

|  |  |  |
| --- | --- | --- |
| **Flask** | **1** | **2** |
| **MnO2** | - | ~1 scoop |
| **40mL** | H2O2 | H2O2 |

*The following reaction will be conducted simultaneously, pay careful attention to mass numbers & time.*

1. Place Flasks on 2 separate scales, and tare the balance.
2. Add approximately scoop of manganese dioxide to #2 and **record the mass of Mn(s) in table 3**
3. **Start time!** Add the H2O2 to the flasks at the same time, and observe the results.
4. Include qualitative and quantitative results & observation in table 4.

***Safety:*** *Weak acid hazard. Wear safety glasses. Wash hands with soap and water. Manganese dioxide- material causing other toxic effects: hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.*

1. Identify **the independent and dependent variables** in this experiment
	1. Independent variable
2. Dependent variable
3. In this experiment, hydrogen peroxide reacts in the presence of a catalyst, manganese dioxide. Write a **hypothesis** which reflects the aim of the experiment.

If

**Observations & Notes:**

**DATA RECORD**

**Name:**  **Date**: / /

**Part A: Effect of Surface Area on Reaction Rate**

**Initial Mass**: CaCO3 (Marble Chips) g CaCO3 (powdered)g

50mL HCL g 50mL HCL g

**Results** Table 1:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time (seconds) | Mass of CaCO3 Marble Chips + 50mL HCl (g) | Change in Mass (grams) | Mass of powdered CaCO3 + 50mL HCl (g) | Change in Mass (grams) |
| 0 |  |  |  |  |
| 30 |  |  |  |  |
| 60 |  |  |  |  |
| 90 |  |  |  |  |
| 120 |  |  |  |  |
| 150 |  |  |  |  |
| 180 |  |  |  |  |
| 210 |  |  |  |  |
| 240 |  |  |  |  |
| 270 |  |  |  |  |
| 300 |  |  |  |  |

**Part B: Effect of Temperature on Reaction Rate**

Record **Results** in Table 2:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Water Bath | Initial Temp (°C) | Final Temp (°C) | Reaction Time (sec.) | Observations |
| Cold |  |  |  |  |
| Warm |  |  |  |  |
| Hot |  |  |  |  |

**Part C: Effect of Concentration on Reaction Rate**

Record **results** in Table 3:

|  |  |  |
| --- | --- | --- |
|  | Temperature (°C) | Observations |
| Time(mins) | **Distilled Water** | **0.5M HCl** | **1.0M HCl** | **3.0M HCl** |
| 0 |  |  |  |  |  |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |

**Part D: Effect of a Catalyst on Reaction Rate**

Record **Results** in Table 4:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Flask #1 | Flask #2 | Observations |
| Initial Mass H2O2 (g)  |  |  |  |  |
| Mass MnO2 (g) |  |  |  |  |
| Final Mass (g)  |  |  |  |  |
| $∆ $Mass (g) |  |  |  |  |
| Reaction Time (sec.) |  |  |  |  |