

## **EXPERIMENT 1** **Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 1:

### **General**

- Data & observations should be tabulated clearly in tables or columnar lab notebook format as described in class. See lab manual pages 1-15 & 1-16 for sample data tables.
- Graphs should be done on graph paper or computer using Excel or similar program. Graphs should include Title, and each axis should be labeled with the proper data label and units.
- Questions should be answered completely in coherent and clear language and include supportive data and information. Questions can be answered on separate sheet of paper and either neatly handwritten or typed.
- Completed lab report should include all of the following materials: 1) copy of lab notebook pages with data; 2) relevant graphs and calculations; 3) answers to questions.

### **Part 1: Mass Measurements**

- Report mass of 2 sets of pennies measured by you and your partner.
- Prepare a graph mass vs. year minted for each penny in each set of measurements. A bar graph would be most appropriate for this data.
- Calculate the mean (average) and standard deviation for each set of pennies measured (see sample calculations in Table 1-1 of lab manual).
- Analyze results of data calculated and determine if any significant difference in the measured mass of the two groups of pennies.
- If a significant difference is present, present a possible hypothesis for this difference.

### **Part 2: Volume Measurements**

- Report the dimensions of the milk carton and the calculated volume in  $\text{cm}^3$ , liters, and quarts.
- Report the two measurements completed in class for the partially filled graduated cylinders.

### **Part 3: Graphing Circumference vs. Diameter of Beakers**

- Report measured circumference and diameter of 4 beakers.
- Prepare a graph of circumference vs. diameter for each beaker measured. A line graph would be most appropriate for this graph.
- Calculate the slope of the graph prepared above.
- Discuss the meaning of the calculated slope and what value it represents.

### **Questions**

- Answer questions 5 and 6 on page 1-14 of the lab manual. Include any calculations that is appropriate to answer each question. Use additional sheet of paper if more space is needed.

## **EXPERIMENT 2** **Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 2:

### **General**

- All measurements must be done with the proper number of significant digits.
- Record all measurements with units.

### **Part 1: Density of Diet & Regular Coke**

- Each group should determine the mass of the one regular and one diet cola can. Obtain the mass of the 5 other regular and diet colas from other groups. Note that each can is numbered separately for ease of tracking.
- Report the average mass of the regular and diet soda cans.
- Calculate the density of the regular and diet soda cans by measuring the mass of an empty can and using 355 mL as the average volume of the can.
- Calculate the % of sugar in the regular soda as directed in the lab manual. Use 3 significant figures for the manufacturers sugar content for the regular soda.

### **Part 2: Buoyancy of Sugared Solutions**

- Qualitatively determine which of the two colored solutions is 8% and which is 16%.
- Carefully add small amount of each colored solution to a test tube containing the other one and observe which test tube will have the more clear boundary between the solutions.

### **Part 3: Quantitative Measurement of Density of Sugared Solutions**

- Use the 10-mL serological pipet to measure mass and volume of each of the colored solutions and water as directed in the lab manual. Obtain a second set of similar data from a nearby group.
- Determine the average mass and density of each solution.

### **Part 4: Graphing Data**

- Prepare a graph of density vs. mass % sugar for the 3 solutions. Water represents 0% sugar solution. Include a title and data labels for the graph.
- Using the calculated density of the regular soda in Part 1 to extrapolate its sugar concentration. Clearly show your extrapolation with a line on the graph.
- Calculate % difference between the two values.

### **Part 5: Density of Solids**

- Determine density of aluminum pellets as described in lab manual.
- Find literature value for density of aluminum and calculate % error for your measurement.

### **Questions**

- No questions required for this experiment.

**EXPERIMENT 4**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 4:

**General**

- All solutions for this experiment are prepared by the lab tech and can be used from the bottles as are. No further dilution or preparation is required.
- Label each reaction well on the plate so that it can be properly identified during the experiment.

**Part 1: Reaction Patterns of Household Chemicals**

- Follow procedure as directed in the lab manual and record observations for each reaction done.
- Observations should be brief, but informative. They should include color changes, formation of precipitates, formation of bubbles, or other similar observations. When no visible changes occur, indicate that by stating “No Reaction”.

**Part 2: Identifying an Unknown**

- Each student will perform reactions on two unknown samples. Record observations for each reaction similar to Part 1.
- After analysis of results, *clearly identify* the unknown number and identity in your lab notebook.

**Questions**

- Answer questions 1 and 2 on page 4-9 of the lab manual.

**EXPERIMENT 5**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 5:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**A Cycle of Copper Reactions**

- Determine the mass of copper before and after the cycle of reactions, and calculate the mass percent recovered after completion of the experiment. Indicate results clearly in your notebook.
- For each step of the reaction cycle, write a balanced chemical equation and classify the reaction type. Include state designations for each substance in the chemical equation.
- Also, include some observations indicating evidence for the reaction. Answer the questions included in the lab manual regarding each step of the reaction.

**Questions**

- Answer questions 1-4 on pages 5-10 and 5-11 of the lab manual.

**EXPERIMENT 7**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 7:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Preparation of Oxygen**

- Include observations for each of the 4 test tubes containing hydrogen peroxide and other substances.
- Answer questions 1a and 1b on page 7-9 of lab manual.

**Part 2: Preparation of Oxides**

- Include observation for the reaction forming each oxide as outlined on page 7-9 of lab manual.
- Write a balanced equation for the formation of each oxide from its element.

**Part 3: Acids and Bases from Oxides**

- Write a balanced equation for the formation of each hydrated oxide as outlined on page 7-10 of lab manual.
- Complete the table near bottom of page 7-10 of lab manual.

**Questions**

- Answer questions 1-4 on pages 7-11 of the lab manual.

**EXPERIMENT 8**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 8:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Reaction of Iodine and Zinc**

- Include data table and observations of the reaction mixture after completion of the reaction.
- Calculate the mass and mole ratios for Iodine and Zinc. Show calculations for each ratio.
- Based on the calculations above, write the empirical formula for zinc iodide.

**Part 2: Isolation of the Zinc-Iodine Reaction Product**

- Include data table and observations of the product isolated from the reaction in Part 1.
- Compare mass of product isolated in part 2 and mass of reactants used in part 1. Calculate percent difference.

**Questions**

- Answer questions 1-5 on pages 8-7 of the lab manual.

**EXPERIMENT 9**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 9:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Reaction of Calcium with Water**

- Include pertinent observation and data for each question on page 9-5 of the lab manual.

**Part 2: Titration of Calcium –Water Reaction Product**

- Include data table titration trials performed in class.
- Show calculations indicated in page 9-6 of the lab manual.

**Questions**

- Answer questions 1-3 in the “Consider This” section on pages 9-7 of the lab manual.

**EXPERIMENT 13**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 13:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Data & Observations:**

- Prepare data for each trial similar to data table on top of page 13-7 in the lab manual. All data must be clearly labeled with units and include the proper number of significant digits.

**Calculations:**

For each trial, calculate the following data from data collected in the previous section. Show complete calculations for one trial.

- Calculate pressure exerted by the water column in mmHg (heights are inversely proportional to density).
- Determine pressure of dry hydrogen gas collected (*gas pressure collected over water*)
- Calculate moles of hydrogen gas produced (*ideal gas law*).
- Calculate mass of metal reacted (*stoichiometry*)
- Calculate the % of metal reacted.
- Calculate volume of hydrogen gas produced at STP (*combined gas law*)
- Calculate equivalence of metal (grams of metal required to produce 11.2 L of H<sub>2</sub> at STP).
- Calculate equivalence of metal (molar mass divided by change in charge of metal).
- Calculate percent error.

**Questions**

- Answer questions 1-4 in the lab manual.



**EXPERIMENT 14**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 14:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Determining the Calorimeter Constant**

- Include data table similar to table on top of page 14-7 of the lab manual.
- Show calculations for each of the following quantities, showing complete work with proper units and significant figures:
  - Heat lost by the hot water ( $\Delta H_{HW}$ )
  - Heat gained by the cold water ( $\Delta H_{CW}$ )
  - Heat gained by the calorimeter ( $\Delta H_{cal}$ )
  - Calorimeter constant (B)

**Part 2: Determining the Specific Heat Capacity of an Unknown Metal**

- Include data table similar to table on top of page 14-8 of the lab manual.
- Show calculations for each of the following quantities, showing complete work with proper units and significant figures:
  - Heat gained by the cool water ( $\Delta H_{CW}$ )
  - Heat gained by the calorimeter ( $\Delta H_{cal}$ )
  - Total heat gained ( $\Delta H_{gained}$ )
  - Specific heat capacity of the unknown metal ( $C_{PM}$ )

**Questions**

- Answer questions on the next page of this handout.

**Questions:**

1. If a metal with a higher specific heat were used, would this raise or lower the final water temperature? Explain.
2. If twice the amount of water were used in this experiment, would this raise or lower the final metal temperature? Explain.
3. What mass of water at  $10.0^{\circ}\text{C}$  would be required to cool  $50.0\text{g}$  of a metal having a specific heat of  $0.60\text{ J/g}^{\circ}\text{C}$  from  $90.0^{\circ}\text{C}$  to  $20.0^{\circ}\text{C}$ ?
4. What would be the final equilibrium temperature if  $80.0\text{g}$  of aluminum at  $5.0^{\circ}\text{C}$  having a specific heat of  $0.90\text{ J/g}^{\circ}\text{C}$  is placed in  $100.0\text{g}$  of water having a temperature of  $60.0^{\circ}\text{C}$ ?

Chemistry 101

5. When determining the specific heat from a given metal in a calorimeter the mass of the water remains constant, but the mass of the metal is increased what would happen to the equilibrium temperature? Explain your choice.

a) increase                      b) decrease                      c) no change

6. In a calorimeter, the equilibrium temperature of copper in water is determined. If the water is replaced with a liquid that has a lower specific heat, what will happen to the equilibrium temperature? Explain your choice

a) not change                      b) increase                      c) decrease

**EXPERIMENT 15**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 15:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Enthalpy Change for Half-neutralization of 10 M H<sub>2</sub>SO<sub>4</sub> and 1.00 M NaOH ( $\Delta H_1$ )**

- Include data table similar to one available on top of page 15-7 of the lab manual
- Calculate each quantity (a–g) indicated in the table on the lower part of page 15-7 of lab manual. (Show work for each quantity calculated)

**Part 2: Heat of Solution of 10 M H<sub>2</sub>SO<sub>4</sub> ( $\Delta H_2$ )**

- Include data table similar to one available on top of page 15-8 of the lab manual
- Calculate each quantity (a–g) indicated in the table on the lower part of page 15-8 of lab manual. (Show work for each quantity calculated)

**Part 3: Enthalpy Change for Half-neutralization of 1.00 M H<sub>2</sub>SO<sub>4</sub> and 1.00 M NaOH ( $\Delta H_3$ )**

- Include data table similar to one available on top of page 15-9 of the lab manual
- Calculate each quantity (a–g) indicated in the table on the lower part of page 15-9 of lab manual. (Show work for each quantity calculated)

**Summary of Results**

- Write a balanced thermochemical equation for each part of this experiment. (See table on top of page 15-10 of the lab manual)
- Calculate the sum of  $\Delta H_2$  and  $\Delta H_3$  and compare with value determined for  $\Delta H_1$ . Calculate the percent error for the two values above.

**Conclusion**

- Write a short paragraph describing how this experiment exemplifies the concept of Hess's Law. Include data calculated in the experiment and use chemical equations to develop your argument.

**Questions**

- Answer the following questions in regards to part 3 of this experiment. (For each question, support your reasoning)
  1. How would your values for heat of the reaction (e) change if you used 100.0 mL of each reagent instead of 50.0 mL.
  2. How would your values for enthalpy of the reaction (g) change if you used 100.0 mL of each reagent instead of 50.0 mL.

**EXPERIMENT 17**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 17:

**General**

- For each step, follow the procedure outlined in the experimental section of the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Calibration of the Spectroscope**

- Complete data table for helium lamp similar to Table I on the handout.
- Determine the relative error of the spectroscope by comparing the measured wavelengths to the given wavelength values in the lab handout.

**Part 2: Energy Level Diagram for Hydrogen**

- Complete data table for hydrogen lamp similar to Table II on the handout. Measured wavelengths are determined directly from the spectroscope.
- Assign each wavelength to an electron transition from  $n_1$  to  $n_2$  using your textbook and lecture notes from class. Calculate the wavelength associated with each transition using the Rydberg equation.
- Complete Table III by calculating percent error for each wavelength observed. Use measured wavelengths obtained in Table II as experimental, and calculated wavelengths using Rydberg equation as theoretical.
- Complete Table IV as follows:
  - Calculate frequency of each transition using  $\nu = c/\lambda$  relationship.
  - Calculate  $\Delta E$  (in J) by using  $E=h\nu$  relationship.
  - Convert  $\Delta E$  from Joules to electron volt (eV)
- Complete Table V by using  $\Delta E$  values calculated above to determine  $E_1$ , by using the following relationship:  $\Delta E (\infty-1) = E_\infty - E_1$  and remembering that  $E_\infty = 0$ .
- Calculate  $E_2$  through  $E_5$  from the corresponding  $\Delta E$  values and similar relationship as described above.
- Plot the energy levels ( $E_n$ ) values for hydrogen atom from data collected in Table V.

**Questions**

- No questions required.

**EXPERIMENT 18**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 18:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Electrolytes and Nonelectrolytes**

- Complete data table outlined in section 1(a) on page 18-7 of lab manual.
- **Note:** No data is required for section 1(b).
- Answer all questions in sections 1(a) and 1(c)

**Part 2: Typical Ionic Reactions**

- Complete all questions in section 2(a) through (c).

**Questions**

- No questions required.

**TITRATION EXPERIMENT**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Titration Experiment:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Standardization of NaOH Solution**

- Data table should include mass of KHP, and initial and final volumes of titrant (NaOH solution). (**Note:** All data should include proper number of significant digits)
- Using stoichiometry, calculate the molarity of the NaOH solution used in each trial. Include a balanced equation for the reaction of KHP with NaOH and show all relevant calculations.
- Calculate the average molarity of NaOH and include the standard deviation for your calculations.

**Part 2: Titration of Vinegar**

- Data table should include volume of vinegar solution, and initial and final volumes of titrant (NaOH solution). (**Note:** All data should include proper number of significant digits)
- Using the average molarity of the NaOH solution calculated in part 1, calculate the molarity of acetic acid in the vinegar solution for each trial. Include a balanced equation for the reaction of acetic acid with NaOH and show all relevant calculations.
- Calculate the average molarity of the vinegar solution and include the standard deviation for your calculations.
- Using the average molarity of the vinegar, calculate the mass percent of the vinegar solution. Report your results with 2 significant figures.
- Compare your results with the percent acid information on the commercial bottle of vinegar and calculate percent error for your results.

**Questions**

- Answer questions 1-3 on handout.

**EXPERIMENT 22**  
**Lab Report Guidelines**

Listed below are some guidelines for completing the lab report for Experiment 22:

**General**

- For each step, follow the procedure outlined in the lab manual. Observe all safety rules, including wearing goggles, during all parts of this experiment.

**Part 1: Determining Freezing Point Constant**

- Complete data table outlined in section 1 on page 22-7 of lab manual. (Note: substitute p-dichlorobenzene in place of unknown)
- Import your data from Lab Quest into an Excel workbook and prepare a graph for pure cyclohexane and one for cyclohexane with p-dichlorobenzene.
- Print the graphs above and draw hand-drawn lines to determine the freezing point for each.
- Calculate the freezing point constant for cyclohexane by completing calculations indicated in table in section 2 on page 22-8 of lab manual.
- Look up the literature value for the freezing point constant of cyclohexane and determine the percent error between your data and the literature value.

**Questions**

- Answer Problem 1 on bottom of page 22-9 of lab manual.