Chemistry Lab: Data Manual®

Tenafly High School

6th edition

Name_____

1. SAFETY LAB REPORT : part 1 (p. 5)

Stations 1 – 6: STATIONS QUESTIONS/ACTIVITIES.
Complete chart.

1. QUESTION: What is the effect of acid on clothing? MATERIALS:	OBSERVATIONS:
2. QUESTION: What is the effect of acid on skin or eyes? MATERIALS:	OBSERVATIONS:
3. QUESTION: How do you safely light a Bunsen burner? MATERIALS:	STEPS:
4. QUESTION: Can all these materials be used to run an experiment? MATERIALS:	OBSERVATIONS:
5. QUESTION: Why is this not a safety station? MATERIALS:	OBSERVATIONS:
6. QUESTION: What is wrong with this lab station? MATERIALS:	OBSERVATIONS:

SAFETY LAB REPORT: part 2

Station #7: EQUIPMENT AND USE. Complete chart.

	Name of Equipment	USE
1.		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

CONCLUSION

State at least one safety rule associated with each station.
(Six safety rules minimum). Use more space if you need it.

NAME_____

2. PHYSICAL AND CHEMICAL CHANGES (p. 7)
PRELAB

PURPOSE:

2. List three examples of a physical change.

3. Give three observable indications that a chemical change has occurred.

OBSERVATION TABLE

Experiment	Observation
1a Burn candle	
1b	
2a	
2b	
2c	
3a	
3b	
4	
5a	
5b	
6a	
6b	

CONCLUSION

1. Summarize your findings in the following chart.

Experiment	Physical/chemical	Explanation
1a		
1b		
2a		
2b		
2c		
3a		
3b		
4		
5a		
5b		
6a		
6b		

2. Does the formation of bubbles always indicate a chemical change? Explain.

3. Does heating a substance always cause a chemical change? Explain using your data.

4. Does burning (combustion) always indicate a chemical change? Explain.

NAME_____

3. OBSERVING SOME PROPERTIES OF FOUR LIQUIDS (p.9)

PRE LAB

1. PURPOSE:

2. List three chemical and five physical characteristic properties of pure substances.

3. How many characteristic properties of two substances must be alike for the two substances to be the same?

4. How many characteristic properties of two substances must be different for the two substances to be the different?

5. What does the formation of bubbles in a liquid indicate?

DATA TABLE

LIQUID	Blue Litmus	Red Litmus	Universal Indicator	Aluminum	Zinc	Manganese Dioxide, MnO_2)
A						
B						
C						
D						
UNKNOWN # _____						

CONCLUSION QUESTIONS

1. Do any liquids share the same properties? If so, explain.

2. Could any two of the liquids be the same? Explain.

3. List three examples of properties that you observed to distinguish between substances.

4. What other chemical and/or physical properties might be used to identify each of the liquids?

5. What is the identity of your unknown? Explain in detail how you identified it.

NAME_____

4. MEASURING DENSITIES OF PENNIES (p. 11)

PRE LAB

1. What is the purpose of this lab activity?

2. Define density.

3. What is the reason for measuring five pennies at a time rather than an individual penny?

4. How is the volume of the pennies determined?

5. Why is it important to work with dry pennies?

6. List the densities for the following metals (use units):

ALUMINUM_____COPPER_____SILVER_____ ZINC_____

Data Table #1: Pre-1982 Pennies

Number of pennies	Mass (g)	Total Volume in cylinder (mL)	Net Volume of Pennies (mL)
5			
10			
15			
20			
25			

Data Table #2: Post-1983 Pennies

Number of pennies	Mass (g)	Total Volume in Cylinder (mL)	Net Volume of Pennies (mL)
5			
10			
15			
20			
25			

CALCULATIONS

Find the slope of each line. Show calculations on the graph:

1. Slope: pre-1982 pennies: **2. Slope: post-1983 pennies:**

CONCLUSION QUESTIONS

1. What do the values you obtained for the slopes of the lines represent?

2. Compare the density of copper obtained for the pre-1982 pennies.

3. Calculate the percent error for the pre-1982 pennies.

4. What is the density of the post-1983 pennies?

5. Compare this value to the density of the metals listed in the prelab.

6. Which metal could be inside the post-1983 pennies? Support your answer.

NAME_____

5. PERCENT COPPER IN A PENNY (P. 13)

	Mass (g)	Observations
Mass dry penny (day 1)		
Mass dry penny (day 2)		

PRELAB.

1. What is the purpose of this lab activity?

CALCULATIONS

CONCLUSION QUESTIONS

1. What is the percent of copper in the penny?

2. Some of the pennies were floating the next day. What was the cause of this?

3. What can you conclude about the effect of hydrochloric acid on copper?

NAME_____

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6.LAW OF DEFINITE COMPOSITION (P. 15)

PRE LAB QUESTIONS

1. State the purpose of the experiment in your own words.

2. Why is it important to start the experiment with a clean and dry crucible?

3. What is the purpose of making sure the surface of the magnesium ribbon is clean and shiny?

4. With what element or elements does the magnesium combine when it is heated in the crucible?

5. In the procedure you are asked to reheat the crucible repeatedly until the last two masses agree to within 0.03 gram. What is the purpose of this reheating?

6. Suppose a compound of sodium and chlorine is formed in a ratio of 1.54 grams of chlorine for each 1.00 gram of sodium. How much sodium would you need to completely react with 45.0 grams of chlorine?

Data Table

Mass of crucible and cover, g	
Mass of crucible, cover and magnesium, g	
Mass of crucible, cover and product, 1st time, g	
Mass of crucible, product and cover, 2nd time, g	
Mass of crucible, product and cover 3rd time, g	

CALCULATIONS: Show your work in the space provided.

Calculations	Results
1. Find the mass of the magnesium that reacted	g
2. Find the mass of the magnesium oxide that was produced.	
3. . Find the mass of oxygen that reacted	
4. Find the ratio of the mass of magnesium to the mass of oxygen	
5. The accepted ratio for the mass of magnesium to the mass of oxygen is 1.5. Calculate the percent error using the formula below.	

$$\frac{\text{(Experimental value – Accepted value) x 100}}{\text{Accepted value}}$$

CONCLUSION QUESTIONS

1. How would your results be affected if some of your magnesium did not react?

2. Use your textbook to help you determine the formula for the magnesium oxide that formed in this experiment.

3. Use the accepted ratio to determine the mass of magnesium that would combine with 16.0 grams of oxygen.

NAME_____

7. PARTICLE SIZE FROM COLLISION PROBABILITIES (P. 17)

PRELAB:

1.PURPOSE:

2. What is probability?

3. How are the target marbles to be lined up?

4. Why will 3 meter sticks be needed?

5. What is the equation for percent error?

DATA TABLE

Total number of marbles rolled (Tr)	
Total number of hits (H)	
Distance between walls (d)	cm
Number of target marbles used (N)	
Total length of 10 marbles (lined up)	cm

CALCULATIONS

1. Calculate the diameter using the equation: $D = \frac{H \times d}{2N \times Tr}$

where:

Tr = number of trials N = number of target marbles

H = number of hits d = distance between the walls

D = diameter

2. Calculate the diameter of one marble using the direct measurement.

3. Calculate the percent error between the calculated and the measured diameter, assuming the measured diameter is the true value.

CONCLUSION QUESTIONS

1. What are some sources of error?

2. How did Rutherford describe the atom as a result of his experiment?

3. In what ways does the situation in this experiment (which is a model of Rutherford's experiment) differ from Rutherford's experiment in which alpha particles were used to bombard a foil composed of gold atoms? (Hint: consider the charges on the subatomic particles.)

NAME_____

8. EMISSION SPECTROSCOPY (P. 19)

PRELAB QUESTIONS

1. Purpose:

2. According the modern theory of the atom, where may an atom's electrons be found?

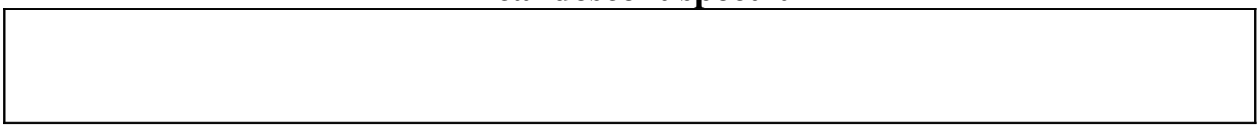
3. How do electrons become "excited"?

4. What form of energy emission accompanies the return of excited electrons to ground state?

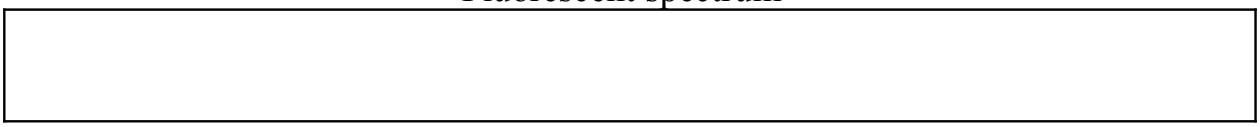
5. State two equations that are used to relate the energy content of a packet of light and its wavelength.

6. A line spectrum is sometimes called a "fingerprint" of an element. What do you think is meant by this term?

Incandescent spectrum



Fluorescent spectrum



Spectra of gaseous elements

Gas tube	Red	Orange	Yellow	Green	Blue	Violet
Argon						
Helium						
Hydrogen						
Mercury						
Neon						

CONCLUSION QUESTIONS

1. Compare the spectra produced by incandescent and fluorescent sources.

2. How are these spectra different from those observed in the discharge tube?

3. What causes the differences in the bright-line spectra of different elements?

4. Which element showed more lines in the red region? The blue-violet region?

5. Prior to its discovery on Earth, the existence of helium was first confirmed in the sun. Explain how this can be possible.

6. Calculate the energy of the red line of the hydrogen spectrum.

NAME_____

9. FLAME TESTS (P. 21)

PRE LAB

1. What is the purpose of this experiment?

2. What is meant by *ground state?*

3. How do electrons become "excited" in this lab?

4. When is the energy absorbed by electrons released?

5. What is the form of this energy?

6. How should the burner flame be adjusted for best results?

7. Why is this lab done without room or outdoor lighting?

METAL	FLAME COLOR
Barium	
Calcium	
Copper	
Lithium	
Potassium	
Sodium	
Strontium	
Mixture of sodium and potassium	
Unknown #_____	
***FLAME COLOR THROUGH COBALT GLASS**	
Potassium	
Sodium	
Mixture of sodium and potassium	

CONCLUSION QUESTIONS

1. What metal ion was in your unknown sample?
2. Explain how you identified your unknown using your data. Be specific.

3. Give two reasons why the flame test is not always valid to identify a metal.

4. What would be observed if a spectroscope were used during a flame test?

5. What color was the flame for the mixture of sodium and potassium? Explain.

6. Is it possible to use the flame tests to identify each individual metal in any mixture? Explain.

NAME_____

10. MENDELEEV FOR A DAY (p. 23)

PRELAB

1.Purpose:

2. How does Mendeleev's periodic table differ from the modern periodic table?

3. Why did Mendeleev leave blank spaces on his periodic table?

4. What is the reason (unknown to Mendeleev) that elements in the same group have similar properties?

5. Why is it necessary to rinse the stirring rod between test tubes?

DATA TABLE Reactions of unknown solutions

Unknowns	A – ppt?	B – ppt?	C - color	D – Dissolved?
1				
2				
3				
4				
5				
6				
7				
8				
9				

CONCLUSION QUESTIONS

1. Why do you think this investigation is titled "Mendeleev for a Day"?

2. Based on your observations, group the unknown solutions into "Families" according to similarities in chemical behavior. Arrange your groups in a chart.

3. Justify your arrangements by referring to your data.

4. Some members of the same "family" that show similar but not identical reactions. Give an example of this.

5. No members of Group 8A (18) of the modern periodic table can be found on Mendeleev's version of the periodic table. Suggest an explanation for their absence.

NAME_____

11. PERIODIC TABLE I:
A STUDY OF REACTIVITY OF METALS (p. 25)

PRELAB:

1. Purpose

2. What is the trend in activity in a Group as the atomic number increases?

3. What is the trend across a Period as the atomic number increases?

PART I: OBSERVATION TABLE: Reactions of metals with water

*also include the description of the reaction with phenolphthalein

METAL	Reaction with water before heating	After heating
Li		These are not heated.
Na		
K		
Rb		
Cs		
Ca		
Mg		
Al		

PART II: OBSERVATION TABLE: Precipitation reactions *

- use NR – no reaction; ppt – precipitate
-

	$Mg(NO_3)_2$ **Mg^{2+}**	$Ca(NO_3)_2$ **Ca^{2+}**	$Sr(NO_3)_2$ **Sr^{2+}**	$Ba(NO_3)_2$ **Ba^{2+}**	Unknown #_____
H_2SO_4 **SO_4^{2-}**					
Na_2CO_3 **CO_3^{2-}**					
K_2CrO_4 **CrO_4^{2-}**					

CONCLUSION QUESTIONS

1. Did this experiment verify the predicted reactivity trend of Group 1A and 2A elements? Explain using your observations.

2. Predict what you would have observed if the following elements had been tested:

Beryllium

Strontium

Francium

3. You observed three elements in period 3 in this lab. Do your observations support the predicted reactivity trend?

4. If zinc and iron had been tested, how would their reactivity compare to the metals in the same PERIOD that you observed in this lab?

5. Describe any relationship that you can determine between the number of precipitates formed by each compound and the location of the alkaline earth metal on the periodic table.

6. What is the identity of your unknown compound? Support your conclusion by referring to your data

NAME_____

12. IONIC AND MOLECULAR COMPOUNDS: COMPARING PROPERTIES (p. 27)

PRELAB

1. Purpose

2. Describe some characteristics of ionic compounds.

3. Describe some characteristics of molecular compounds.

Substance	Does it melt?	Does it dissolve?	Does the solution conduct?	Classify Ionic/molecular
1. **table salt NaCl**				
2. **Sugar $C_{12}H_{22}O_{11}$**				
3. **Salt substitute KCl**				
4. **epsom salts**				
5. **paraffin**				
6. **aspirin**				
7. **Urea**				

CONCLUSION QUESTIONS

1. Complete the statements:

a) The following substances _____are ionic because

b) The following substances _____are molecular because

2. If you know the formula of the compound can you predict whether it is ionic or molecular? Explain.

3. Predict the following, based on the patterns established in this experiment:

a) Solubility of sodium iodide in water(high/low) _____

b) Relative melting point of benzoic acid (C_6H_5COOH) (high/low) _____

c) Electrical conductivity of glucose in water _____

d) Electrical conductivity of magnesium chloride in water _____

NAME_____

13. MODELS OF COVALENT COMPOUNDS (p. 29)

PRELAB.

1. Purpose

2. What properties of compounds are determined by the shape of the molecule?

3. What shapes can molecules have?

4. How can you determine if BOND is polar or nonpolar?

5. Predict the **bond type** (ionic, polar covalent, nonpolar covalent) for the following, show the electronegativities differences for each pair.
   a. Na and Cl_____
   b. C and H_____
   c. S and O _____
   d. N and N_____
6. What factors determine if a MOLECULE is polar or nonpolar?

CONCLUSION QUESTIONS.

1. Which shapes always produce polar molecules?

2. List the NONPOLAR MOLECULES which have POLAR BONDS.

3. Both water and carbon dioxide are molecules composed of three atoms and two bonding clouds. One is polar and the other is nonpolar. Explain why.

4. Why is CH_3Cl polar, while CCl_4 is not?

5. The polarity of a substance can have a great effect on its solubility. A rule of thumb for solubility is "like dissolves like". Knowing this general rule , can you predict the polarity of alcohol if you know that alcohol dissolves in water?

6. Classify each of the compounds using one of the following: (*Refer to the electronegativity chart to determine bond type).*

   Polar covalent bonds in polar molecules
   Polar covalent bonds in nonpolar molecules
   non polar covalent bonds in nonpolar molecules

   a) I_2_____
   b) CBr_4_____
   c) H_2S_____
   d) NaF_____

MODELS OF COVALENT COMPOUNDS

Formula	**Sketch**	**Dot diagram**	**Bond type*** (polar/nonpolar)	**Type of molecule** (polar/nonpolar)	**Shape**
H_2					
HCl					
Cl_2					
H_2O					
CH_4					
NH_3					
CH_3Cl					

* Use electronegativity table.

CCl_4					
C_2H_6					
O_2					
CO_2					
C_2H_4					
C_2H_2					
HCOOH					
$(PO_4)^{3-}$				**N. A**.	

NAME_____

14. CHEMICAL NAMES AND FORMULAS (p. 31)

PRE LAB

1. What is the purpose of this lab activity?

2. What is a precipitate?

3. When is a roman numeral used in a name?

4. Which cations require the use of roman numerals?

5. What is a cation? List the **cations** in this experiment.

6. What is an anion? List the **anions** in this lab activity.

TABLE FOR PART I

Potassium iodide	Sodium chloride	Magnesium sulfate	Copper II sulfate

$NaHCO_3$	$FeCl_3$	$NaNO_3$	KBr

Sodium carbonate	Lead II nitrate	Sodium acetate	Ammonium chloride

$CaCl_2$	$AgNO_3$	$CoCl_2$	CuCl

(ppt) = precipitate formation (indicate color of precipitate)

TABLE FOR PART II: Names and Formulas

	$AgNO_3$ **(Ag^{+1})**	$Pb(NO_3)_2$ **(Pb^{+2})**	$CuSO_4$ **(Cu^{+2})**	$Mg\ SO_4$ **(Mg^{+2})**	$FeCl_3$ **(Fe^{+3})**
$FeCl_3$ **(Cl^{-1})**	1. **silver chloride** **AgCl**	6.			
KI **(I^{-1})**	2.	7.			
NaOH **(OH^{-1})**	3.	8.	11.	14.	17.
Na_2CO_3 **(CO_3^{-2})**	4.	9.	12.	15.	18.
Na_3PO_4 **(PO_4^{-3})**	5.	10.	13.	16.	19.

CONCLUSION QUESTIONS

1. In each box in **table for part II,** write the name and formula of the precipitate formed.
   **Reaction #1 has been done for you.
   Reminder: Some names will require Roman Numerals

2. Write the formulas for the following compounds: lead (II) chloride_____,

   lead (II) chlorate_____, zinc phosphate_____,

   zinc phosphide_____

3. Using your answers in question #2, explain how do you distinguish between the binary ionic compounds and ionic compounds with polyatomic ions.

NAME_____

15. COMPOSITION OF HYDRATES (P. 33)

PRELAB

1. Purpose:

2. Calculate the theoretical percent of water in the following hydrates.
(HINT: One of these will be your unknown!)

$MgSO_4 \cdot 7\ H_2O$

$CuSO_4 \cdot 5\ H_2O$

$BaCl_2 \cdot 2\ H_2O$

$Na_2SO_4 \cdot 10\ H_2O$

$CaCl_2 \cdot 2\ H_2O$

DATA TABLE

Sample number #	
mass of evaporating dish (g)	
mass of evaporating dish + hydrate	
mass of evaporating dish + anhydrous salt (after first heating)	
mass of evaporating dish + anhydrous salt (after second heating)	
mass of evaporating dish + anhydrous salt(after third heating, if needed)	

CALCULATIONS

1. Calculate the mass of water lost: (hydrate + dish) - (anhydrous salt + dish) (use final heating value)	
2. Calculate mass of hydrate: (hydrate + dish) - dish	
3. Calculate % water in hydrate: $\frac{\text{mass of water lost}}{\text{mass of hydrate}} \times 100$	
4. Calculate the % error.	

CONCLUSION QUESTIONS

1. Write the number and complete formula of your unknown hydrate.

2. Why did you select it from the list? Use your calculations to support your choice.

3. Why do you think it is necessary to measure the mass of the anhydrous salt immediately after cooling?

4. A hydrate compound has a mass of 1.632g before heating and 1.008g after heating. Compute the experimental percentage of water in the hydrate.

NAME_____

17. EMPIRICAL FORMULAS (p. 37)

PRELAB

1. Purpose:

Show all work, and circle final answer:

2. A 0.750 g sample of tin is oxidized with nitric acid to form tin oxide. Calculate the empirical formula of tin oxide if the original tin sample gained 0.201 g of oxygen.

3. Excess sulfur reacts with 0.565 g of cobalt to give 1.027 g of cobalt sulfide. Find the empirical formula of the product.

4. If 1.164 g of iron filings reacts with chlorine gas to give 3.384 g of iron chloride, what is the empirical formula of the compound?

5. Why should you wait at least 5 minutes before masses the evaporating dish?

DATA

Unknown #	
1. Mass of the evaporating dish	
2. Mass of evaporating dish and powder, "AB"	
3. Mass of evaporating dish and "A" after first heating	
4. Mass of evaporating dish and "A" after second heating	

CALCULATIONS	**RESULTS**
1. Calculate the mass of unknown compound AB (before heating).	
2. Calculate the mass of "A". (after last heating)	
3. Calculate the mass of "B".	
4. Using the masses of "A" and "B" and the "atomic masses" given in the reference table, calculate the empirical formula of your compound "AB".	

CONCLUSION QUESTIONS

1. What is the number and empirical formula of your compound?

2. What is an empirical formula?

3. What additional information would you need to calculate the molecular formula?

NAME_____

18. SINGLE REPLACEMENT REACTIONS (P. 39)

PRE LAB QUESTIONS

1. Purpose:

2. Why must the spot plate be cleaned after each trial?

3. During a single replacement reaction what happens to a metal that is least reactive?

DATA TABLE

	$Cu(NO_3)_2$	$Pb(NO_3)_2$	$Zn(NO_3)_2$	$AgNO_3$	HCl	$Mg(NO_3)_2$
Pb(+2)						
Cu(+2)						
Zn(+2)						
Mg(+2)						

SYMBOLS:
R- reaction – change in metal
g - gas
NVR - no visible reaction

CONCLUSION QUESTIONS

1. Write balanced equations for each reaction that occurred.

2. Based on your observations, list metals in the order of decreasing activity. (Most active metal first).
Justify your answer.

NAME_____

19. DOUBLE REPLACEMENT REACTIONS (p. 41)

PRELAB

1. State the purpose of the experiment.

2. What are cations? Give two examples.

3. What are anions? Give two examples.

4. Where are anions found on the periodic table?

5. Where are cations found on the periodic table?

6. What is a solution?

7. What is a precipitate?

Data Table

	KI	**NaCl**	**NaOH**	**$FeCl_3$**	**Na_2SO4**	**Na_3PO_4**	**Na_2CO_3**	**$CuSO_4$**
$AgNO_3$								
$Pb(NO_3)_2$								
$CaCl_2$								

CONCLUSION QUESTIONS

1. How do you know a double replacement reaction occurs?

2. What two CATIONS commonly form precipitates?

3. Which CATIONS never form precipitates?

4. Which ANIONS never appear in a precipitate?

5. Write balanced chemical equations for all the precipitation reactions of $AgNO_3$ that you observed. Be sure to combine ions in formulas according to their charges. Mark the precipitate with an *(s)*.

6. Write balanced chemical equations for all the precipitation reactions of $CaCl_2$ that you observed.

Table for under plastic

	KI	NaCl	NaOH	$FeCl_3$	$NaSO_4$	Na_3PO_4	Na_2CO_3	$CuSO_4$
$AgNO_3$	X	X	X	X	X	X	X	X
$Pb(NO_3)_2$	X	X	X	X	X	X	X	X
$CaCl_2$	X	X	X	X	X	X	X	X

NAME_____

20. 4 SOLUTION PROBLEM (p. 43)

Data Table 1:

	$AgNO_3$	KSCN	NaOH	$FeCl_3$
$AgNO_3$	**X**			
KSCN	**X**	**X**		
NaOH	**X**	**X**	**X**	
$FeCl_3$	**X**	**X**	**X**	**X**

Data Table 2:

	$AgNO_3$	KSCN	NaOH	$FeCl_3$
A				
B				
C				
D				

CONCLUSION QUESTIONS:

1. Write the chemical and net ionic equation for each reaction in which a precipitate was formed from Table 1.

2. What is the identity of the unknown pipets?

A=_____ **C=**_____

B=_____ **D=**_____

NAME_____

21. TYPES OF CHEMICAL REACTIONS (p. 45)

PRE LAB

1. What is the purpose of this lab?

2. Write balanced chemical equations to describe the following chemical reactions and identify each type of reaction:

a) Aluminum reacts with the oxygen in the air to form aluminum oxide.

_____

Type:_____

b) Hydrogen peroxide, H_2O_2, decomposes into water and oxygen gas.

_____

Type:_____

c) Hydrochloric acid reacts with magnesium to produce hydrogen gas and magnesium chloride.

_____

Type:_____

d) Hydrochloric acid also reacts with sodium hydroxide to produce table salt and water.

_____

Type:_____

DATA TABLE

REACTION	OBSERVATIONS
A	
B	
C	
D	
E	

ANALYSIS AND CONCLUSION

1. In the tables below:

a) Study the observations you recorded and then identify the type of reaction that took place in each case (A-E) in the table below

b) Write ***balanced equations*** for each reaction.

REACTION TYPE	**BALANCED EQUATION**
A	
B	
C	
D	
E	

NAME_____

22.A CHEMICAL REACTION: MOLES OF IRON AND COPPER (P. 47)

PRE LAB

1. Purpose:

2. What are the two possible formulas for iron chloride? _____

3. Write the two balanced equations that could occur in this lab when iron reacts copper II chloride. (In one assume $FeCl_2$ is formed and in the other $FeCl_3$).

_____

_____

4. What does it mean to decant in the context of the lab activity?

5. Why must the product of this reaction be completely dry before massing?

DATA

1. Mass of the100 mL (small) beaker, g	
2. Mass of the beaker and $CuCl_2$, g	
3. Mass of the nail before the reaction, g (dry and clean)	
4. Mass of the nail after the reaction, g (dry and clean)	
5. Mass of beaker and dry copper, g (dry and clean)	

CALCULATIONS	RESULTS
1. Mass of copper formed,	g
2. Moles of copper	moles
3. Mass of iron reacted	g
4. Moles of iron	moles
5. Ratio of moles of iron to moles of copper	
6. Equation	

CONCLUSION QUESTIONS

1. What type of reaction is this?

2. Can a reaction occur with copper nails and iron chloride? Explain.

NAME_____

23. MOLE AND MASS RELATIONSHIP(p.49)

PRELAB

1. What is the purpose of this lab?

2. What information is given by the coefficients in chemical reaction?

3. What is a ratio? Give an everyday example of a ratio.

4. How are ratios related to chemical reactions?

5. How can you show that mass is conserved in a chemical reaction?

Data Table

1. Evaporating dish - watch glass	g
2. Evaporating dish-watch glass-$NaHCO_3$	g
3. Evaporating dish-watch-dry NaCl	g

Calculations	Results
1. Find the mass of $NaHCO_3$	g
2. Find the number of moles of $NaHCO_3$	moles
3. Find the mass of NaCl	g
4. Find the number of moles of NaCl	moles
5. Calculate the theoretical yield	g
6. Calculate the % yield	%

CONCLUSION QUESTIONS

1. According to the balanced equation for the reaction used in this experiment, what is the ratio of moles of $NaHCO_3$ to moles of NaCl?

2. Using your data, calculate, the moles of $NaHCO_3$ you used and the moles of NaCl that formed in this experiment. What is the mole ratio? Is it the same as the ratio, obtained from the balanced equation?.

3. What is the % yield? How do the theoretical yield and the actual yield compare? What might be the source of error if yield is less than 100%? If it is greater than 100%?

4. If the masses of all but one of the substances that take part in a chemical reaction are known, explain, why is it possible to determine the unknown mass by subtraction?

NAME_____

24. CHANGE OF PHYSICAL STATE: Cooling Curves (p. 51)

PRE LAB

1. Purpose:

2. List the four changes a substance can undergo and state whether each is endothermic or exothermic.

3. Which phase changes will be observed in **this** lab activity?

4. What do you predict will be the relationship between the freezing point and melting point?

5. In what phase will the Lauric acid be at the start of the experiment?

6. How will you determine the freezing point and melting point from your data?

DATA

Time minutes	Part I Temperature ºC	Part II Temperature ºC
0		
0.5		
1		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		
5.5		
6.0		
6.5		
7.0		
7.5		
8.0		
8.5		
9.0		
9.5		
10.0		
10.5		
11.0		
11.5		
12.0		
12.5		

CONCLUSION QUESTIONS

1. Construct graphs with *time* on the x-axis and *temperature* on the y-axis. Use your data to construct <u>two</u> lines. Use the same set of axes for both graphs. Draw a smooth curve through the points.

2. Does the temperature of the substance vary while it is freezing or melting?

3. Using your cooling curve, determine the freezing point of lauric acid. _____

4. *Determine the melting point of lauric acid. How do both temperatures compare?

5. Explain the diagonal parts of the cooling curve in terms of changes in kinetic and potential energy. Do the same for the horizontal portions of the curve.

6. Explain how an increase in the amount of lauric acid used would affect the shape of the curves.

7. Explain in your own words what is going on at the molecular level as the liquid Lauric acid cools and freezes?

NAME_____

25. BOYLE'S LAW (p. 53)

PRE-LAB QUESTIONS

1. Purpose:

2. State Boyle's law.

3. What is constant?

4. What is the conversion from grams to kilograms?

5. What does the Newton (N) measurement represent?

DATA TABLE

Mass (kg)	**Weight (N) #1**	**Pressure (Pa) #2**	**Volume (down) (mL)**	**Volume (up) (mL)**	**Average V_{avg} (mL) #3**	**P_{atmos} (Pa) #4**	**Total Pressure P_t (Pa) #5**	**Constant V_{avg} x P_t # 6**
0								
.5								
1.0								
1.5								
2.0								

CONCLUSION QUESTIONS

1. State a generalization about the effect of pressure on the volume of gases at constant temperature.

2. What kind of a relationship is shown by the graph?

3. When no weights are on the plunger, there is still pressure being exerted on the gas in the cylinder. This is the P_{atm}. What causes that pressure?

4. Does this experiment verify Boyle's Law, within experimental error? Explain how it does

NAME_____

26. DETERMINATION OF ABSOLUTE ZERO (p. 55)

PRE LAB

1. Purpose:

1. State Charles' Law. Explain what each letter in formula represents.

2. What does **extrapolate** mean in respect to graphing.

3. What is the equation for percent error?

DATA TABLE

1. Temperature of boiling water, T_1	°C
2. Temperature of ice water, T_2	°C
3. Volume of water drawn in V_d	mL
4. Volume of water in filled flask V_1	mL

2.

CALCULATIONS	RESULTS
1. Convert T_1 to K	**K**
2. Convert T_2 to K	**K**
3. Initial volume of gas, V_1 (volume of full flask)	**mL**
4. Calculate final volume of gas, $\mathbf{V_2}$, using experiment data ($\mathbf{V_1 - V_d}$).	**mL**
5. Calculate volume, V_2, using Charles' Law	**mL**
6. Value for Absolute zero from the graph (x-intercept from your graph)	**°C**
7. Theoretical value for Absolute zero	**°C**
8. Percent error	**%**

CONCLUSION QUESTIONS

1. Does this lab illustrate Charles' Law? Explain.

2. You calculated the value for V_2 (calculation 5) and determined it experimentally (calculation 4). How do the two values compare?

3. Use your graph to determine what would be the volume of the sample of gas in the flask when the temperature is 50°C?

NAME_____

27.MOLAR VOLUME OF A GAS (p. 57)

PRE LAB

1. What is the purpose of this lab activity?

2. Write the balanced equation for the reaction of magnesium and hydrochloric acid.

3. What is the ratio of moles of magnesium used to moles of hydrogen produced in the reaction?

4. What is meant by **STP?**

5. What is a eudiometer? What two gases will be collected in the eudiometer?

6. What piece of information, from a reference table will you need in order to complete the calculations in this experiment?

DATA TABLE

	Trial 1	**Trial 2**
Mass of magnesium ribbon (g)		
Barometric pressure (mm Hg)		
Temperature (°C)		
Volume of H_2 in tube (mL)		
Vapor pressure of H_2O (mmHg)		

CALCULATIONS **RESULTS**

	Trial 1	Trial 2
1. Mass of Mg used		
2. Moles of Mg used		
3. Moles of H_2 produced (use the mole ratio from the equation)		
4. Pressure of H_2 (use the total pressure and the partial pressure of water)		
5. Volume of H_2 gas at STP (use the combined gas law)		
6. Volume of one mole H_2 (use the proportion)		
7. Average volume of one mole of H_2 (average of two trials)		
8. Percent error, using the average volume.		

CONCLUSION QUESTIONS

1. What are some sources of error in this experiment?

2. How would the volume of the hydrogen collected differ if twice as much Mg had been used?

3. What happens to the other product of the reaction formed in this experiment?

4. A volume of 35.0 ml of nitrogen gas was collected over water at 23°C and 753 mm Hg. The vapor pressure of water is 21.1 mm Hg. **Show all work for calculations.**

   a) What is the pressure of nitrogen gas alone?

   b) What would the volume of the gas be at STP?

   c) What should be the volume of one mole of this gas at STP?

5. Find the volume of the following masses of gases at STP:

a) 80 g O_2 b) 66 g CO_2

6. How many liters would the following moles of any gas occupy at STP?

a) 0.25 mole b) 3.50 mole

NAME_____

28. CHROMATOGRAPHY (p. 59)

1. Purpose

2. What is a solvent? What is/are the solvent(s) used in this activity?

3. Where is the mixture placed on the chromatography paper before placement in the solvent?

4. Why does the mixture travel up the paper once placed in the solvent?

5. What does separation of the mixture indicate?

6. What is a chromatogram?

* STAPLE YOUR CHROMATOGRAMS TO YOUR LAB REPORT.

DATA TABLE

Substance	D_f (cm)	D_s (cm)	R_f
Marker name:			
Marker name:			

CONCLUSION QUESTIONS

1. What is the purpose of the process of chromatography?

2. What causes the components to separate?

3. Which markers appear to contain only one compound? Explain.

4. Which markers appear to be mixtures? Explain.

5. Were there any colors which seemed to be the same in different markers?
(Compare with other students results at your table.)

6. Why is it important to mark the chromatography paper with pencil, not pen?

NAME_____

29. ICE CREAM LAB (p. 61)

CONCLUSION QUESTIONS

1. What were the temperatures of the pure ice and the ice with salt?

2. Why was salt added to the ice?

3. What phase change occurred in the milk?

4. Is the change exothermic or endothermic?

5. Describe what happened to the heat in the reaction.

6. If you did not add sugar would the ice cream have frozen faster? Explain your answer.

7. Why did the outside of the large bag get wet? (Assume that your bag did not spring a leak.)

8. Why is salt spread on the roads during a winter storm?

NAME_____

30. RATES OF REACTION (p. 63)

PRE LAB

1. In your own words, state the purpose of the experiment.

2. What factor is varied in Part I?

What factor is constant?

3. What factor is varied in Part II?

What factor is constant?

4. What is the purpose of the starch in the experiment?

5. Why is it necessary to have two 10 mL graduated cylinders for this activity?

PART I DATA TABLE: Effect of concentration

Experiment	Vol A (mL)	Vol water (mL)	Vol B (mL)	Time (sec)	Average time (sec)	Rate 1/time 1/sec	
1	6	1	3				
2	5	2	3				
3	4	3	3				
4	3	4	3				
5	2	5	3				
6	1	6	3				

PART II DATA TABLE: Effect of temperature

Temperature	Vol A (mL)	Vol water (mL)	Vol B (mL)	Time		Average time
	4	3	3			
*	4	3	3			

* Use data from Part I with the same dilution. **Record room temperature.**

CONCLUSION

1. Based on your experimental data, make a general statement about the effect of concentration of reactants on time and rate.

2. Make a similar statement about the effect of temperature on reaction rate.

3. What other factors affect the rate of a reaction?

NAME_____

31.INVESTIGATION OF CHEMICAL EQUILIBRIUM (p. 65)

PRE LAB

1. State the purpose of this activity

2. State the ways a system at equilibrium can be disturbed.

3. What type of systems will be affected by pressure?

4. What is a spectator ion?

PART I: DEMONSTRATION

Treatment	Prediction	Results	Change in concentration: indicate as increase , decrease ↓
PART I: DEMO			
System I Add HCl **(Cl^-)**			**$NaCl_{(s)} \rightleftarrows Na^+(aq) + Cl^-(aq)$** _____ _____ _____
System II Add HCl **(H^+)** Add NaOH **(OH^-)**			**yellow Blue** **$HBB \rightleftarrows H^+ + BB^-$** _____ _____ _____ _____ _____ _____
System III Add $Fe(NO_3)_3$ **(Fe^{3+})** Add KSCN **(SCN^-)** Add NaOH **(OH^-)**			**pale yellow colorless dark red** **$Fe^{3+} + SCN^- \rightleftarrows FeSCN^{2+}$** _____ _____ _____ _____ _____ _____ _____ _____ _____
PART II: ACTIVITY			
System IV Heat solution **(+ heat)** Cool solution **(- heat)** Add NaCl **(Cl^-)** Add $AgNO_3$ **(Ag^+)**			**green blue** **$CuCl_4^{2+}(aq) \rightleftarrows Cu^{2+}(aq) + 4\ Cl^-(aq) + heat$** _____ _____ _____ ____ _____ _____ _____ ____ _____ _____ _____ ____ _____ _____ _____ ____

CONCLUSIONS

1. Write the equilibrium constant expressions for each system used.

2. Using examples from this lab (including demo), describe each of the ways equilibrium systems were disturbed. Be specific about what was added or removed in each example.

3. Which type of change on a system was not done in this lab?

4.List at least four spectator ions in this lab.

If heat is added to an **exothermic** reaction, which increases: products or reactants?

5. If heat were added to an **endothermic** reaction, which increases: products or reactants?

6. In general, what must be done to remove a reactant or product?

NAME_____

32. CHANGE IN ENTHALPY (p. 67)

PRELAB

1. Purpose:

2. Define enthalpy

3. Write the equation for the decomposition of hydrogen peroxide into water and oxygen gas.

4. The reaction may occur in two steps. The energy for each step is given. Use this information to calculate the net energy released**. This will be the theoretical or calculated value in kJ/mol.**

$$H_2 + \tfrac{1}{2} O_2 \rightarrow H_2O \quad \Delta H = -286 \text{ kJ/mol}$$

$$H_2O_2 \rightarrow H_2 + O_2 \quad \Delta H = +191 \text{ kJ/mol}$$

5. Calculate the heat released when 31 mL of hydrogen peroxide solution are decomposed and the temperature changes from 21.3°C to 37.6°C. Assume the density of the solution is the same as water (1g/mL) and use the specific heat of water 4.18 J/g ·°C.

DATA TABLE

Volume of 3% hydrogen peroxide	
T_i	
T_f	
Observations after highest temperature is reached	

CALCULATIONS	RESULTS
1. Change in enthalpy	
2. Convert to kJ	
3. Mass of H_2O_2	
4. Moles of H_2O_2	
5. ΔH in kJ/mol	
6. % = experimental/theoretical	

CONCLUSION QUESTIONS:

1. How will the mass of the calorimeter and contents change throughout the experiment? Explain.

2. Compare your results to the theoretical value. How do they compare? Refer to your data in your answer.

3. Suggest two reasons for the difference between your results and the theoretical value.

4. The decomposition of hydrogen peroxide is slow. If poured on the table there is no evidence of decomposition. On the other hand when 3% hydrogen peroxide is applied to a cut, the decomposition begins immediately (bubbles appear). Use your knowledge of biology to suggest a reason why this occurs.

NAME_____

32. pH AND INDICATORS (p. 69)

PRELAB

1. Purpose

2. Describe the pH scale.

3. What is an indicator?

CONCLUSION QUESTIONS

1. Which would be the best indicator only to distinguish all acids from all bases?

2. Identify your unknown. Justify your answer by referring to your data. Answer in complete sentences.

3. Using the table, list the indicators, the pH range over which the color is changing, and the colors in the acidic range and the basic range.

INDICATOR	pH RANGE WHERE COLOR CHANGES	COLOR	
		ACID	BASE

PH	Crystal Violet	Methyl Orange	Phenol Red	BTB	Alizarin Yellow	Phenol Phthalein	Universal
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
_Unknown #							

NAME_____

34. ACID/BASE TITRATION (P. 71)

DATA TABLE I: PRACTICE TECHNIQUE

Buret Reading	Trial 1		Trial 2		Trial 3	
	ACID HCl	0.10 M NaOH	ACID HCl	0.10 M NaOH	ACID HCl	0.10 M NaOH
Final						
Initial						
Volume used						

CALCULATIONS

1. Calculate the molarity of the HCl (M_a) using your data.

2. Find the average of the three trials and calculate the % error, assuming the actual molarity is 0.10 M.

.

DATA TABLE II: UNKNOWN ACID

Number of unknown sample of acid _____

Buret Reading	Trial 1		Trial 2		Trial 3	
	ACID	0.10 M NaOH	ACID	0.10 M NaOH	ACID	0.10 M NaOH
Final						
Initial						
Volume used						

CALCULATIONS

1. Calculate the molarity of your unknown acid for each trial.

2. Find the average

NAME_____

35.UNDERSTANDING HALF LIFE (p. 73)

PRELAB QUESTIONS

1. State the purpose of the experiment in your own words.

2. What is meant by the term *half-life*?

3. What is the half life of carbon-14?

4. How can carbon-14 help in determining the age of a fossil?

5. Suppose you have a radioactive isotope with a half-life of 2 years and you start with 800 grams of this substance today.

   a. How much will you have left 2 years from today?

   b. How much will you have left 8 years from today?

6. Is the quantity of a radioactive isotope ever equal to exactly zero? Explain your answer.

DATA TABLE#1: Starting Number of Pennies

Shake Number	Number pennies Removed
0	0

DATA TABLE#2:

Shake Number 1 shake = 5 seconds	Number pennies Remaining
0	200

CONCLUSION QUESTIONS

1. Make a graph of your results: x-axis time, y-axis pennies remaining.

2. Describe the shape of your graph.

3. If you had started with 1000 pennies, would the shape of the graph be different? Explain why or why not.

4. Approximately what percent of the pennies were removed each time?

5. Is it possible to identify which pennies will be "heads" up? Explain.

6. Is it possible to predict approximately how many pennies will be "head" up for each shake? Explain.

NAME_____

36. DETERMINING THE HALF-LIFE OF Ba-137m
DATA SHEET (p. 75)

PRELAB

1. Purpose:

2. If you are taking a 5 minute background reading, how do you calculate the counts per minute (cpm) ?

3. If your readings are taken for 30 seconds, how do you calculate the cpm (gross)?

4. How do you calculate the cpm (net) from the cpm (gross)?

DATA

Background radiation _____counts/_____ = _____cpm

Time Interval	Counts/30sec	Cpm (gross)	Cpm (net)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			

CONCLUSION QUESTIONS

1. Based on your graph, what is the half-life of Ba-137m? Remember to show your work.

2. If the "accepted" value for the half-life is 2.6 minutes, what is your percent error? Show your calculation. If you plotted your graph in seconds, remember to convert your units
.

3. Some Cs-137 is always mixed into the Ba-137m sample. Does this affect the measurement of the half-life of the Ba-137m sample? Explain why or why not.

4. Why is it safe to throw the remaining Ba-137 down the drain after 10 or 15 minutes?

37. BACK TO CHERNOBYL (P. 77)

NAME_____

QUESTIONS FOR "BACK TO CHERNOBYL" DOCUMENTARY

1. When did the incident occur?_____. Where did it occur?_____

2. How many reactors were on the site?_____ Which one was involved in the accident?_____

3. What was burning?_____

4. Who were the first responders to the site?_____

5. What happened to the trees around the reactor and why? _____

_____

6. How many casualties were reported as an immediate result of the accident?_____

7. How did the Soviets try to put out the fire?_____

8. When were the people informed of the accident?_____ How long after the accident was the order given to evacuate the city of Pripyat?_____

9. Why did the Soviets try to withhold the information about the accident from the people?
_____

10. What device was being used to detect and measure radiation?_____

11. Why were robots not effective in the clean-up process?_____

12. How long were miners and other workers allowed to work at the site on the clean-up?
_____

13. What was done to contain the radiation from the damaged reactor?
_____

14. How were contaminated materials from the surrounding area dealt with?_____

15. What are the main differences between the Soviet reactors and the Western reactors?
_____

_____

16. What would have happened if it had rained at the time of the accident? _____
_____

17. Where did the winds carry the radioactive fallout? _____

_____

18. How many countries received considerable amounts of radiation? _____

_____

19. What food supplies were especially affected?_____

20. As a result of the Chernobyl accident, what new regulations were developed by scientists?

_____

_____

NAME_____

AFTER VIEWING

1. What are two lessons to be learned from the accident?

_____

_____

2. The cause(s) of the accident can be divided into two categories: human error and design flaws. Describe them. (at least 2 for each category.)

_____

_____

_____

_____

3. Do you think that nuclear energy is a good substitute for fossil fuels which are responsible for the environmental problems as pollution and global warming? (There is no correct answer.) Support your position.

_____

_____

_____

_____

_____

_____

_