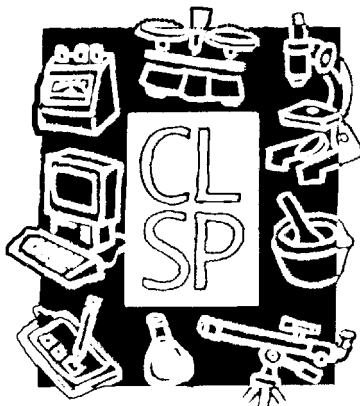


TECHNICAL SKILL MODULE

PREPARATION OF PERCENT SOLUTIONS

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CALIFORNIA LABORATORY SPECIALIST
PROGRAM

Funded by the California Science Project

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PREPARATION OF PERCENT SOLUTIONS

INTRODUCTION

GOAL: The goal is to provide the students with the skills to calculate and prepare percent solutions for use by science teachers in the school laboratory.

PERFORMANCE OBJECTIVES: Upon completion of the activities in this module, the student will be able to:

1. Determine the proper amount of solute, solid or liquid, and solvent to prepare a mass-volume percent, mass percent, or volume percent solution with precision and accuracy to a known concentration.
2. Find the mass and/or volume of required solute and solvent using a beam or electronic balance or using a variety of graduated laboratory glassware.
3. Use safe and effective techniques in combining chemicals in preparation of solutions.
4. Use safe and effective techniques in transferring solutions into containers and proper labeling processes.

PREREQUISITE SKILLS: Student should have satisfactorily mastered the techniques in the Mass and Volume module and have completed the modules on Chemical Safety and Laboratory Safety.

MATERIALS NEEDED:

Balances:

beam and/or electronic balances, weighing paper, and weighing vessels
(Electronic balances are preferred because of the small mass samples

usually required.)

Graduated cylinders and Erlenmeyer flasks:

variety of glassware from 1000 mL, 500 mL, 250 mL, and 100 mL with rubber stoppers as required.

Beakers:

variety of glass beakers from 1000 mL, 600 mL, 400 mL, 250 mL, and 150 mL.

Containers:

a variety of laboratory containers and vials with lids or stoppers to contain prepared solutions.

General laboratory glassware and equipment and safety equipment.

Chemicals, solids and liquids, to prepare specified solutions.



SUGGESTED TIMELINE:

Day/Period	Instructional Activity (Time Allocation)	Topic/Skill	Student Exercise
1	Primary Instruction First Session (40 min) Supervised Practice (30 min) Introduction to Independent Practice (10 min)	Percent Solutions Discussion, Skill, & Calculations	PERCENT SOLUTION CALCULATIONS
2	Independent Practice	Percent Solution Calculations	PERCENT SOLUTION CALCULATIONS
3	Primary Instruction Second Session (40 min) Supervised Practice (30 min) Introduction to Independent Practice (10 min)	Percent Solution Preparation	PERCENT SOLUTION PREPARATION
4	Independent Practice (60 min)	Percent Solution Preparation	PERCENT SOLUTION PREPARATION
5	Performance Assessment (60 min)	Percent Solution Calculations & Preparations	EVALUATION: PERCENT SOLUTION

**PRIMARY INSTRUCTION
FIRST SESSION****INSTRUCTOR'S GUIDE****PERCENT SOLUTIONS: DISCUSSION, SKILLS, & CALCULATIONS**

This session should be devoted to the discussion of percent solutions, skills in calculating the mass and/or volume of solutes and solvents, and calculating the proper mass and/or volume of solutes and solvents to prepare a percent solution.

Well-trained students should be familiar with the information on chemical labels for chemical nomenclature and mass data, the Periodic Table of Elements for reference, what a solution is composed of, know the difference between mass-volume; mass percent; and volume percent solutions, and demonstrate proficiency in these areas.

The following topics should be discussed and demonstrated. Those items marked with an asterisk (*) are prerequisites to the practice sessions. Emphasis should be based on those percent solutions utilized in the school laboratory.

***MASS PERCENT SOLUTIONS:** Determined by the mass in grams of solute per 100 grams of solution (grams solute + grams solvent).

$$\text{Mass percent (m/m)} = \frac{\text{mass of solute in grams}}{\text{mass of solution in grams}} \times 100$$

Example: 5 grams of sodium chloride in 100 grams of solution is 5% by mass.

***VOLUME PERCENT SOLUTIONS:** Determined by the volume in milliliters of solute per 100 milliliters of solution (milliliters solute + milliliters solvent).

$$\text{Volume percent (v/v)} = \frac{\text{volume of solute in mL}}{100 \text{ mL of solution}} \times 100$$

Example: 20 mL of ethyl alcohol in 100 mL of water is a 20% by volume solution.

***MASS-VOLUME PERCENT SOLUTIONS:** Indicated by w/v%. Determined by the mass in grams of solute per 100 milliliters of solution.

$$\text{Mass-volume percent (w/v\%)} = \frac{\text{mass of solute in grams}}{100 \text{ mL of solution}} \times 100$$

Example: 1 gram of Phenolphthalein in 100 mL of 95% ethyl alcohol is a 1 w/v% solution.

Reference material:

Flinn Chemical & Biological Catalog, Reference Manual, Laboratory Solution Preparation section.

**PERCENT SOLUTIONS
SUPERVISED PRACTICE****INSTRUCTOR'S GUIDE****DISCUSSION, SKILLS, AND CONCEPTS**

This session is to acquaint the student with:

1. the concept of percent solutions and those used in the school laboratory; and
2. the calculations involved in preparing percent solutions.

Emphasis should be placed on mass percent solutions and mass-volume percent solutions. Most percent solutions used in the school laboratory setting are in these two categories.

MASS PERCENT SOLUTIONS:

Determine the mass in grams of the solute per 100 grams of solution (grams solute + grams solvent). Water is used as the solvent.

$$\text{Mass percent (m/m)} = \frac{\text{mass of solute in grams}}{\text{mass of solution in grams}} \times 100$$

Demonstrate the process of determining the amount of solute and solvent to make a 5% solution of sodium chloride. Have the student repeat the process for a 10% solution of the same solute.

Give the student a different solute of a specified percentage. Have them repeat the process for the new solution.

Repeat the process until the student becomes confident and capable of using this concept.

VOLUME PERCENT SOLUTIONS:

Determine the volume in milliliters of the solute per 100 milliliters of solution (milliliters solute + milliliters solvent). Water or 95% ethyl alcohol can be used as the solvent.

$$\text{Volume percent (v/v)} = \frac{\text{volume of solute in mL}}{100 \text{ mL of solution}} \times 100$$

Demonstrate the process of determining the volume of solute and solvent to make a 10% solution of ethyl alcohol. EXAMPLE: 10 mL of ethyl alcohol in 90 mL of water (making approximately 100 mL of solution) is a 10% solution of ethyl alcohol.

Have the student repeat the process for a 15% solution of the same solute.

Give the student a different solute and solvent of a specified percentage. Have them repeat the process for the new solution.

Repeat the process until the student becomes confident and capable of using this concept.

MASS-VOLUME PERCENT SOLUTIONS:

Indicated by w/v%. Determine the grams of solute per 100 milliliters of solution.

$$\text{Mass-volume percent (w/v\%)} = \frac{\text{mass of solute in grams}}{100 \text{ mL of solution}} \times 100$$

- Demonstrate the process of determining the amount of solute and solvent to make a 1% solution of Phenolphthalein in 95% ethyl alcohol. EXAMPLE: 1 g of Phenolphthalein in 100 mL of 95% ethyl alcohol is a 1% solution (w/v%) of ethyl alcohol.
- Have the student repeat the process for a 2.5% solution of the same solute.



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- Give the student a different solute and solvent of a specified percentage. Have them repeat the process for the new solution. Most mass-volume percent solutions are in the range of 0.02% to 5%.
- Repeat the process until the student becomes confident and capable of using this concept.



**PERCENT SOLUTIONS
INDEPENDENT PRACTICE**

INSTRUCTOR'S GUIDE

PERCENT SOLUTION DETERMINATIONS

PREPARING THE STUDENT

This set of exercises is designed to be completed by the student without the assistance of an instructor and is designed to be self-checking. Since they will be working alone and may not be able to get immediate help, it is important that you spend time with them before hand discussing the exercise. They should be able to use their notes, previous calculations, and a have quiet place to work.

If the proper discussion, skill development, and calculation processes were developed, students should display the proper confidence in accomplishing the independent practice.

Emphasis is placed on mass percent solutions and mass-volume percent solutions as most percent solutions used in the school laboratory are in these two categories.

PART 1: MASS PERCENT SOLUTIONS:

Students should have their notes, a calculator, and scratch paper. Students will be choosing their own chemicals for determining the mass of the solute and the solvent to prepare a 3% mass-mass solution. Use water as the solvent.

Students should report the masses to two decimal places, the precision of most laboratory balances is 0.01 g and the volume to the nearest milliliter.

PART 2: MASS-VOLUME PERCENT SOLUTIONS:

Students should have their notes, a calculator, and scratch paper. Students will be choosing their own chemicals for determining the mass of the solute and the liquid solvent to prepare a 1% mass-volume solution. Use ethyl alcohol as the solvent.

Students should report the masses to two decimal places, the precision of most laboratory balances is 0.01 g.

Students should review the Mass and Volume module on the graduated cylinder. The precision is based on the graduated cylinder used in volume measurements.

EXAMPLES:

0.1% Methyl Green, Solvent 95% ethyl alcohol, 0.1 g of Methyl Green, dilute to final volume of 100 mL.

1% Methyl Orange, Solvent 95% ethyl alcohol, 1 g of Methyl Orange, dilute to final volume of 100 mL.

PART 3

Prior to this exercise, choose two chemicals and two different percent solutions for the student to use. The chemicals should be similar to those used previously during the Skills and Calculation session. Utilize both mass percent and mass-volume percent solution concepts.

A key of the correct mass or volume for the chemicals and percent solutions should be prepared for the verifying instructor. The student should see the need for accuracy in the solute and solvent determination.

NOTE:

The Laboratory Solution Preparation section of the Flinn catalog, Chemical and Biological Catalog Reference Manual, contain numerous examples for percent solutions.



PERCENT SOLUTIONS

NAME _____

SUPERVISED PRACTICE

PERIOD _____ DATE _____

PERCENT SOLUTIONS: CALCULATIONS & MEASUREMENT PRACTICE

This exercise is designed to increase your confidence in calculating the mass of solute required to prepare a specific percent solution and then to obtain the required mass using the proper laboratory equipment.

MASS PERCENT SOLUTIONS:

STEP 1

Obtain the necessary laboratory equipment to determine the solute mass for sodium chloride, NaCl, to prepare 100 g of a 10% solution. Water will be used as the solvent. Review balance use material.

Determine the amount of sodium chloride required for this solution. _____g

STEP 2

Using the beam balance, complete 1 and 2 in the following data table. (Using an electronic balance and the tare function, complete 3 in the following data table.)

- | | |
|--|--------|
| 1. Mass of weighing paper | _____g |
| 2. Mass of (chemical) + weighing paper | _____g |
| 3. mass of (chemical) | _____g |

STEP 3

Determine the mass of solvent required to prepare this solution. _____g

STEP 4

Clean and return all laboratory equipment and chemicals.

MASS-VOLUME PERCENT SOLUTIONS:

STEP 1

Obtain the necessary laboratory equipment to determine the mass of solute for Phenolphthalein to prepare 100 mL of a 1% solution. 95% ethyl alcohol will be used as the solvent. Review mass and volume use material.

Determine the amount of Phenolphthalein required for this solution. _____g

STEP 2

Using the beam balance, complete 1 and 2 in the following data table. (Using an electronic balance and the tare function, complete 3 in the following data table.)

- | | |
|--|--------|
| 1. Mass of weighing paper | _____g |
| 2. Mass of (chemical) + weighing paper | _____g |
| 3. mass of (chemical) | _____g |

STEP 3

The final solution volume is 100 mL by definition of a mass-volume solution.

STEP 4

Clean and return all laboratory equipment and chemicals.



PERCENT SOLUTIONS

NAME _____

INDEPENDENT PRACTICE

PERIOD _____ DATE _____

PERCENT SOLUTIONS: CALCULATIONS & MEASUREMENT

In the Supervised Practice you used the skills from previous modules and those in this module to determine the amount of solute for a given percent solution and to accurately measure the required mass or volume of the solute to prepare the solution.

This exercise again requires the same skills with an additional emphasis on accuracy in mass and volume determinations and measurements.

PART 1 MASS PERCENT SOLUTIONS

STEP 1

Acquire the necessary laboratory equipment to measure and calculate amount of solute and solvent required to prepare a mass percent solution. Prepare the balance for proper use.

STEP 2

You have been given a specific chemical and the percent solution to be prepared. Water will be used as the solvent

Determine the mass of solute and solvent required to prepare 100 g of a 25% solution. Show all calculations. Solute _____ g Solvent _____ g

STEP 3

Using the beam balance, complete 1 and 2 in the following data table. (Using an electronic balance and the tare function, complete 3 in the following data table.)

- | | |
|--|---------|
| 1. Mass of weighing paper | _____ g |
| 2. Mass of (chemical) + weighing paper | _____ g |
| 3. mass of (chemical) | _____ g |

STEP 4

Clean and return all laboratory equipment and chemicals.

Instructor Verification

_____ has successfully completed **PART 1** of this exercise

Instructor



PART 2 MASS-VOLUME PERCENT SOLUTIONS

Your instructor will give you a chemical. Your task is to determine the mass to the nearest 0,01 g required to prepare 100g of a 20% solution using this compound and to determine the amount of solvent required. Water will be used as the solvent.

Completing Part 2 with reasonable accuracy will receive the Instructor's Verification for the Part 2

Complete the following table by performing the calculations and measurements.

Solute _____g Solvent _____g

Measurement: Solute Using the beam balance, complete 1 and 2 in the following data table.(Using an electronic balance and the tare function, complete 3 in the following data table.)

- | | |
|--|--------|
| 1. Mass of weighing paper | _____g |
| 2. Mass of (chemical) + weighing paper | _____g |
| 3. mass of (chemical) | _____g |

_____has successfully completed **PART 2** of this exercise

Instructor



**PRIMARY INSTRUCTION
SECOND SESSION**

INSTRUCTOR'S GUIDE

PREPARING PERCENT SOLUTIONS

This session is to show the student the proper techniques in preparing a percent solution using the calculations developed in the first session, a beam or electronic balance, and graduated laboratory glassware. The techniques should be discussed and demonstrated more than once using various pieces of equipment and glassware. Those marked with an asterisk (*) are prerequisites to the practice exercises.

- *Magnetic stirrer apparatus (if available) or stirring rod
- * Clean graduated cylinders (various sizes) and beakers (various sizes)
- *Beam and/or electronic balances (Electronic balances are preferred because of the small mass samples usually required.)
- *Proper handling of chemicals: storage, dispensing, mixing, pouring, and labeling.
- *Safety:
 - Proper safety equipment: goggles, aprons, and gloves (as required)
 - Cleaning chemical spills.
 - Chemical control and storage



PREPARATION OF PERCENT SOLUTIONS

SUPERVISED PRACTICE PERCENT SOLUTIONS

Emphasis is placed on mass percent solutions and mass-volume percent solutions as most percent solutions used in the school laboratory are in these two categories.

Acid-base indicators and biological stains are often specified as percent solutions.

$$\text{Mass-volume percent (w/v\%)} = \frac{\text{mass of solute in grams}}{100 \text{ mL of solution}} \times 100$$

This is used mainly when the solute is a solid, like Phenolphthalein, for acid-base indicators. Most commonly used in the school laboratory.

$$\text{Volume percent (v/v)} = \frac{\text{volume of solute in mL}}{\text{volume of solution in mL}} \times 100$$

This is used mainly when the solute is a liquid, like ethyl alcohol, since its volume is easily obtainable.

$$\text{Mass percent (m/m)} = \frac{\text{mass of solute in grams}}{\text{mass of solution in grams}} \times 100$$

This is commonly used to express the concentration of commercial aqueous reagents such as nitric acid.



INDEPENDENT PRACTICE

PREPARING PERCENT SOLUTIONS

The purpose of this exercise is to re-enforce the determination of the amount of solute and solvent required and the mass and volume measurements for percent solutions and to develop the skills needed in preparing the finally solution.

NOTE:

The Laboratory Solution Preparation section of the Flinn catalog, Chemical and Biological Catalog Reference Manual, contains numerous examples of percent solutions. Choose those percent solutions that can be utilized in the school laboratory.

PREPARING THE STUDENT

The student should be well versed in the calculations necessary to prepare percent solutions. Check on previous knowledge to insure they have retained a mastery of the calculations by having them determine the mass of solute needed to prepare the solution to be used in a demonstration and then have them measure the correct mass of the solute to be used.

MASS-VOLUME PERCENT SOLUTIONS

PART 1

Verbally demonstrate the proper procedures to be followed in preparing 100 mL of a 0.2% solution. The student should follow the procedures in the demonstration and perform the procedures under the instructor's guidance. Transfer the prepared solution to a properly labeled container.

PART 2

The student should use the same chemical to prepare 100 mL of the 0.5% solution using the following relationship:

$$\% = \frac{\text{mass of solute in grams}}{100 \text{ mL of solution}} \times 100$$

to calculate the proper amount of solute to be used. Following the same procedures as demonstrated in Part 1, prepare the required solution.

PART 3

Given a new compound and % concentration, have the student demonstrate the proper procedures in the preparation. The student should follow their notes on the preparation of the solution.

The instructor should give both positive and negative verbal instruction.

MASS PERCENT SOLUTIONS

PART 1

Verbally demonstrate the proper procedures to be followed in preparing 100 g of a 10% solution. The student should follow the procedures in the demonstration and perform the procedures under the instructor's guidance. Transfer the prepared solution to a properly labeled container.



PART 2

The student should use the same chemical to prepare 100 g of the 15 % solution using the following relationship:

$$\% = \frac{\text{mass of solute in grams}}{100 \text{ mL of solution}} \times 100$$

to calculate the proper amount of solute to be used. Following the same procedures as demonstrated in Part 1, prepare the required solution.

PART 3

Given a new compound and % concentration, have the student demonstrate the proper procedures in the preparation. The student should follow their notes on the preparation of the solution.

The instructor should give both positive and negative verbal instruction.



PREPARATION OF PERCENT SOLUTIONS NAME _____
SUPERVISED PRACTICE PERIOD ___ DATE _____

PREPARING PERCENT SOLUTIONS
PART 1

STEP 1

To perform this exercise, you will need the proper equipment to prepare 100 mL of a 0.04% solution. The solvent will be 95% ethyl alcohol. Complete the equipment list below and then have the equipment list checked by your instructor.

EQUIPMENT NAME	SIZE (IF APPLICABLE)	EQUIPMENT NAME	SIZE (IF APPLICABLE)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

STEP 2

You have been given a labeled vial by your instructor containing the chemical to be used for the solution shown in Part 1. Determine the following:

Mass of chemical (solute) to prepare the solution _____g
Amount of 95% ethyl alcohol (solvent) to be used in the solution _____mL

Have your data checked by your instructor.

STEP 3

Following the proper procedures, make the solution and place it in a labeled 250 mL Erlenmeyer flask. Have your solution checked by your instructor.

Instructor Verification

_____ has successfully completed **PART 1** of this exercise

Instructor



PREPARATION OF PERCENT SOLUTIONS

NAME _____

INDEPENDENT PRACTICE

PERIOD _____ **DATE** _____

PREPARING PERCENT SOLUTIONS

PART 2

STEP 1

This exercise is similar to Part 1. You will increase your confidence in Part 2 by reviewing the past procedures and processes in preparing percent solutions

Your instructor has given you a labeled vial containing the chemical for this exercise. You are to prepare 100 g of a 1% solution. With water as the solvent.

STEP 2

To perform this exercise, you will need the proper equipment to prepare the solution.

EQUIPMENT NAME	SIZE (IF APPLICABLE)	EQUIPMENT NAME	SIZE (IF APPLICABLE)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

STEP 2

Perform the proper calculations.

Mass of chemical (solute) to prepare the solution _____ g

Amount of 95% ethyl alcohol to be used in the solution _____ mL

STEP 3

Following the proper procedures, make the solution and place it in a labeled 250 mL Erlenmeyer flask. Have your solution checked by your instructor.

Instructor Verification

_____ has successfully completed **PART 1** of this exercise

Instructor



EVALUATION:

INSTRUCTOR'S GUIDE

Performance Rating

The evaluation of competency when laboratory skills are involved can become quite complex since so many factors come into play. We are not just interested in the final product obtained, but the means by which the product is obtained. Different students will progress through different levels of skill as they learn and practice. For that reason we suggest you consider the following system as you evaluate the process of your students.

Level 1:

The student has been introduced to information and/or procedures. The student requires direct instruction and practice before application can be expected.

Level 2:

The student can perform procedures and/or use equipment or chemicals but only under direct supervision. The student requires additional practice.

Level 3:

The student can perform reasonably after receiving clear instructions for all that is expected. Supervision may be required for some procedures. Continuing practice is advisable.

Level 4:

The student can initiate and perform procedures on request. Supervision is not needed beyond legal requirements. The student is capable of instructing others.

To evaluate the work of the student in this unit and to determine his/her skill level as outlined above you will need to consider two areas of concern.

First, you will need to evaluate the numerical answers obtained. In the sections that follow, suggested criteria are given for the range of answers. They follow three categories: Proficient, Pass, and Needs Further Work.

Proficient infers that the answer represents a high level of skill and can be considered the "correct" answer.

Pass infers that the student can obtain a reasonably good answer, although not with the highest level of precision and accuracy.

Needs Further Work suggests that the student should obtain more instruction and practice before performing duties which require this skill.

Second, you will need to evaluate the procedures the student used while performing the task. You might consider such matters as: the use of safe procedures, the maintenance of an uncontaminated work area, the amount of time needed to complete the task effectively, the amount of supervision required, the ability to locate and properly use equipment, etc. To help you in this evaluation, Part 5 of the student's evaluation requires they submit a listing of all of the steps used to reach the answer. As another possibility (time and other logistical matters permitting) you might simply wish to observe the students as they go through the evaluation phase.



PREPARATION OF PERCENT SOLUTIONS

INTRODUCTION:

This evaluation consists of five parts. The **part 1** is to determine the amount of solute and solvent that is required to produce 100 mL of solution of a given percent concentration. The **part 2** checks the calculations in part 1 and actually making the required percent solution. The **part 3** is to determine the amount of solute and solvent that is required to produce 100 g of solution of a given percent concentration. The **part 4** checks the calculations in part 3 and actually making the required percent solution. **Part 5** is the culmination of the evaluation where the student outlines the equipment to be used, the determinations needed, and the procedures for producing a mass percent solution and a mass-volume percent solution.

The student will not be able to complete the evaluation in one class period. The instructor should choose those parts to accurately evaluate the skills of the student and those to be utilized in the school laboratory environment..

PART 1

The student will be given a specific chemical and percent concentration, The student should have the use of a calculator. The student will determine the mass of solute and volume of solvent to produce 100 mL to the given percent concentration.

Suggested criteria:

- Understands the concepts of solute, solvent and solution and the processes to determine the mass of solute and volume of solvent required to prepare the solution. *Proficient*
- Understands the concepts of solute, solvent and solution and the processes to determine the mass of solute and volume of solvent required to prepare the solution with minor errors or corrections. *Pass*
- Understands the concepts of solute, solvent and solution with errors and/or corrections and requires corrections on mass and volume determinations. *Needs Further Work*

PART 2

The student will use the data determined in **part 1** and the necessary laboratory equipment and skills the prepare the required mass-volume percent solution. The student should also have the use of a calculator.

Suggested criteria:

- Follows calculations required and produces the given solution. *Proficient*
- Follows calculations required and produces the given solution with a few cautions or reminders. *Pass*
- Follows calculations required with a few cautions or reminders and produces the given solution with a number of cautions or reminders. *Needs Further Work*

PART 3

The student will be given a specific chemical and percent concentration, The student should have the use of a calculator. The student will determine the mass of solute to produce 100 g to the given percent concentration.

Suggested criteria:

- Understands the concepts of solute, solvent and solution and the processes to determine the mass of solute and solvent required to prepare the solution. *Proficient*
- Understands the concepts of solute, solvent and solution and the processes to



determine the mass of solute and solvent required to prepare the solution with minor errors or corrections. *Pass*

Understands the concepts of solute, solvent and solution with errors and/or corrections and requires corrections on mass determinations. *Needs Further Work*

PART 4

The student will use the data determined in **part 3** and the necessary laboratory equipment and skills to prepare the required mass percent solution. The student should also have the use of a calculator.

Suggested criteria:

- Follows calculations required and produces the given solution. *Proficient*
- Follows calculations required and produces the given solution with a few cautions or reminders. *Pass*
- Follows calculations required with a few cautions or reminders and produces the given solution with a number of cautions or reminders. *Needs Further Work*

PART 5

Part 5 requires that the student be able to write out the equipment to be used in preparing a solution, how the amount of solute and solvent is determined to produce the required solution, and the procedures to follow making the solution. They have completed these tasks previously in Supervised and Independent Practice, but this will be the first time they have combined all these tasks together. This part of the evaluation will be a determination of their past knowledge and the ability to present the procedure in the Preparation of Percent Solutions to other students.

The student is to accurately determine the various pieces of laboratory equipment that will be needed to produce the solution including proper names and sizes, to go through the criteria needed to calculate the molar mass and the mass of solute required to make a specific percent solution with a given volume, and to write the procedures to be followed in making the required solution.

Suggested criteria:

- Names laboratory equipment to be used with proper sizes, follows the criteria for determining the mass and volume of the solute and solvent within acceptable limits, and accurately develops the correct procedure to be followed to produce a percent solution. *Proficient*
- Names laboratory equipment to be used with proper sizes with a few omissions, follows the criteria for determining the mass and/or volume of the solute and solvent within acceptable limits, and accurately develops the correct procedure to be followed to produce a percent solution with few omissions. *Pass*
- Names laboratory equipment to be used with proper sizes with a number of important omissions, follows the criteria for determining the mass and/or volume of the solute and solvent but not within acceptable limits, and develops the procedure to be followed to produce a percent solution with a number of important omissions. *Needs Further Work*



PREPARATION OF PERCENT SOLUTIONS

NAME _____

EVALUATION:

PERIOD _____ **DATE** _____

PREPARING PERCENT SOLUTIONS

The following are a series of tasks to determine your mastery and skills that have been developed in this module. You will be working alone on this evaluation and need to achieve the best results possible.

PART 1

Your instructor has given you a chemical formula. The chemical will be used to make 100 mL of a 1% solution.

Find the mass of solute and volume of solvent to produce the required solution. Show all work.

Completed: _ Proficient
 _ Pass
 _ Needs Further Work

Instructor

PART 2

Your instructor has provided you with the necessary laboratory equipment to make the given solution. Use your calculations in part 1 to produce the required percent solution. Use proper laboratory equipment and procedures and follow proper laboratory safety procedures. Prepare the solution in part 1.

Completed: _ Proficient
 _ Pass
 _ Needs Further Work

Instructor



PART 3

Your instructor has given you a chemical formula. The chemical will be used to make 100 g of a 10% solution.

Find the mass of solute and solvent to produce the required solution. Show all work.

Completed: — Proficient
 — Pass
 — Needs Further Work

Instructor

PART 4

Your instructor has provided you with the necessary laboratory equipment to make the given solution. Use your calculations in part 3 to produce the required percent solution. Use proper laboratory equipment and procedures and follow proper laboratory safety procedures. Prepare the solution in part 3.

Completed: — Proficient
 — Pass
 — Needs Further Work

Instructor

PART 5

This part of the evaluation is the culmination of the module. This portion will determine your overall mastery of the module.

1) You are to make a list by name and size, as applicable, of all the laboratory equipment to be used in making a percent solution.

EQUIPMENT NAME	SIZE (IF APPLICABLE)	EQUIPMENT NAME	SIZE (IF APPLICABLE)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____



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2) Write out the criteria for determining the amount of solute and solvent required to make a mass percent solution. (Use the back of the Evaluation Sheet if necessary.)

3) Write out the steps of the procedure that are required to actually produce the solution. (Use the back of the Evaluation Sheet if necessary.)

Completed: — Proficient
 — Pass
 — Needs Further Work

Instructor