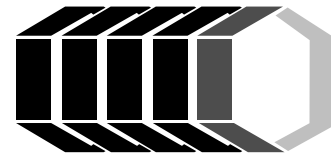




1998 U.S. NATIONAL CHEMISTRY OLYMPIAD

NATIONAL EXAMINATION—PART III



Prepared by the American Chemical Society Olympiad Examinations Task Force

OLYMPIAD LABORATORY PRACTICAL TASK FORCE

Lucy Pryde Eubanks, Clemson University
Chair

Robert Becker, Kirkwood High School, Kirkwood, MO

Craig W. Bowen, University of Southern Mississippi, Hattiesburg, MS

J. Emory Howell, University of Southern Mississippi, Hattiesburg, MS

Sheldon L. Knoespel, Michigan State University, East Lansing, MI

Jim Schmitt, Eau Claire North High School, Eau Claire, WI

Robert G. Silberman, SUNY-Cortland, Cortland, NY

Christie Borgford Summerlin, University of Alabama-Birmingham, Birmingham, AL

DIRECTIONS TO THE EXAMINER-PART III

The laboratory practical part of the National Olympiad Examination is designed to test skills related to the laboratory. Because the format of this part of the test is quite different from the first two parts, there is a separate, detailed set of instructions for the examiner. This gives explicit directions for setting up and administering the laboratory practical.

There are two laboratory tasks to be completed during the 75 minutes allotted to this part of the test. Students do not need to stop between tasks but are responsible for utilizing their time in the best way possible. **Each procedure must be approved for safety by the examiner before the student begins that procedure.** Students should be permitted to use non-programmable calculators.

Part III 2 questions laboratory practical 1 hour, 15 minutes

A periodic table and collection of physical constants are included on the last page for student reference. Students should be permitted to use non-programmable calculators.

DIRECTIONS TO THE EXAMINEE-PART III

DO NOT TURN THE PAGE UNTIL DIRECTED TO DO SO. WHEN DIRECTED, TURN THE PAGE AND READ THE DETAILED DIRECTIONS VERY CAREFULLY BEFORE YOU PROCEED.

There are two laboratory-related tasks for you to complete during the next 75 minutes. There is no need to stop between tasks or to do them in the given order. Simply proceed at your own pace from one to the other, using your time productively. **You are required to have a procedure for each problem approved for safety by an examiner before you carry out any experimentation on that problem.** You are permitted to use a non-programmable calculator. At the end of the 75 minutes, all answer sheets should be turned in. Be sure that you have filled in all the required information at the top of each answer sheet. Carefully follow all directions from your examiner for the proper disposal of chemicals at your examining site.

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PART III — LABORATORY PRACTICAL

Student Instructions

Introduction

These problems test your ability to design and carry out laboratory experiments and to draw conclusions from your experimental work. You will be graded on your experimental design, on your skills in data collection, and on the accuracy and precision of your results. Clarity of thinking and communication are also components of successful solutions to these problems, so make your written responses as clear and concise as possible.

Safety Considerations

You are required to wear approved eye protection at all times during this laboratory practical. You also must follow all directions given by your examiner for dealing with spills and with disposal of wastes.

Lab Problem 1

Galvanized steel has a thin coating of zinc to prevent corrosion of the underlying steel. You have been given two galvanized steel washers, 3M HCl, and appropriate measuring devices. Devise and carry out an experiment to determine how many atoms thick the zinc coating is on the steel washer. You will be asked to describe the method you developed to solve this problem. You also will be asked to analyze your assumptions in solving this problem.

Given: density of zinc = $7.14 \text{ g}\cdot\text{mL}^{-1}$
atomic mass of zinc = $65.39 \text{ g}\cdot\text{mol}^{-1}$
Avogadro constant, $N_A = 6.022 \times 10^{23}$

Lab Problem 2

You have been given an unknown amino acid solution which could contain proline, glutamic acid, or lysine. You also have a solution of 0.10 M NaOH and two different acid-base indicators provided in labeled Beral-type pipets. Devise and carry out an experiment to identify your unknown acid. You will be asked to describe the method you developed to solve this problem.

Amino Acid	pK_1	pK_2	pK_3
proline	2.00	10.60	
glutamic acid	2.10	4.07	9.47
lysine	2.18	8.95	10.53
Indicator	pH Transition	Acid Color	Base Color
methyl red	4.8–6.0	red	yellow
thymolphthalein	8.3–10.5	colorless	blue

Answer Sheet for Laboratory Practical **Problem 1**

Student's Name: _____

Student's School: _____ **Date:** _____

Proctor's Name: _____

Local Section: _____ **Student's USNCO test #:** _____

1. Briefly describe your experimental plan. List the equipment and materials you plan to use and the steps you plan to take to solve this problem. (CAUTION: The acid solution used in this problem is 3 M, more concentrated than used in many microscale experiments. Please follow all safety precautions explained by the examiner at the start of this lab practical.)

Before beginning your experiment, you must get approval (for safety reasons) from the examiner.

Examiner's initials:

2. Record your data and other observations.

3. Calculate the thickness of the zinc coating on the galvanized steel washer, reporting your answer in atoms of zinc. Be sure to clearly show all methods used for calculation and to include units as appropriate.

Calculated thickness:	atoms Zn
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4. Explain what assumptions were made in determining the thickness of the zinc coating on the steel washer. How does each assumption influence the value of the thickness you calculated?

Answer Sheet for Laboratory Practical **Problem 2**

Student's Name: _____

Student's School: _____ **Date:** _____

Proctor's Name: _____

Local Section: _____ **Student's USNCO test #:** _____

1. Briefly describe your experimental plan. List the equipment and materials you plan to use and the steps you plan to take to solve this problem.

Before beginning your experiment, you must get approval (for safety reasons) from the examiner.

Examiner's initials:

2. Record your data and other observations.

3. Identify your unknown amino acid and explain how you arrived at its identity.

Unknown Amino Acid:	
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