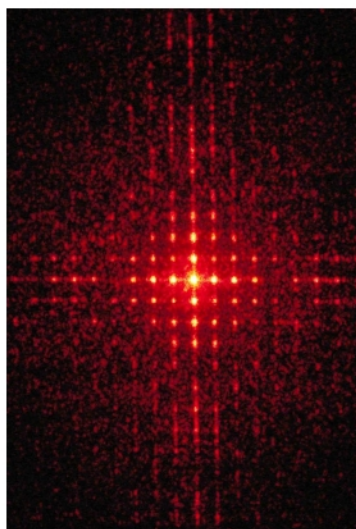


Spring  
2024

## THE UNIVERSITY OF TEXAS AT TYLER

# CHEM 3155: PChem II Lab

### A Hands-on Laboratory Course Introducing Kinetics and Quantum Mechanics



(adapted from Dr. Rachel Mason)

**Instructor: Dr. Kai Zhang**

kzhang@uttyler.edu

903/566-6276

RBS 3007A

**Office Hours: MWF10am-12 noon**

I practice an open door policy—any time my door is open you are welcome to stop in and I will help you as time allows. If I can't talk right then, we'll set an appointment for a different time.

**Class Meetings: RBS 4014**

**TR 1:30pm-5:30 pm**

**16 Jan - 4 May 2023**

#### Word from the Wise:



"I am among those who think that science has great beauty. A scientist in his laboratory is not only a technician: he is also a child placed before natural phenomena which impress him like a fairy tale."

Marie Skłodowska Curie - As quoted in *Madame Curie: A Biography* (1937) by Eve Curie Labouisse, as translated by Vincent Sheean, p. 341

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## Course Description

Physical Chemistry is concerned with the physical principles underlying the properties of chemical substances. In order to learn physical chemistry, students must become familiar with the experimental foundations on which the theoretical principles are based. Generally, the ability to utilize the principles requires an intimate knowledge of experimental techniques. For this reason, the lecture course in physical chemistry is accompanied by this laboratory course. This course is the second in a two semester sequence. It is concerned primarily with reinforcing concepts and developing experiences with experimental techniques in kinetics, quantum mechanics and spectroscopy.



## Learning Objectives

**By the end of the course the students should be able to:**

- Thoroughly understand and apply principles, laws and theories of introductory physical chemistry discussed in lecture.
- Utilize common laboratory apparatus, instruments and equipment to measure physical properties of substances.
- Demonstrate good laboratory technique and skills.
- Learn and work independently.
- Work cooperatively with others.



## Course Pre-and Co-requisites

**Course Prerequisites are:**

- General Chemistry I & II Lab/Lecture
- Organic Chemistry I & II Lab/Lecture
- Analytical Chemistry Lab/Lecture
- Physical Chemistry I Lab/Lecture
- University Physics I & II (calculus based)
- Calculus I & II



**Additionally:**

Additionally, students must show credit for or be concurrently enrolled in Chem 3354: Physical Chemistry II Lecture.

## Important Administrative Dates

**Students should be aware of these dates:**

Refer to academic calendar



**Required Textbook:**

There is no required textbook for the course. All instructional material will be posted on the course Canvas site. Students are expected bring the printed laboratory exercise to class with them.

Students should have a Physical Chemistry textbook for reference. The associated Physical Chemistry lecture course is using *Atkins' Physical Chemistry* 11<sup>th</sup> edition by Atkins, de Paula & Keeler (ISBN: 9780198769866), but any current physical chemistry text is acceptable. Including the free Chem Libre text found here: <https://chem.libretexts.org/Bookshelves>

**Additional Supplies:**

Students are required to have:

- Laboratory notebook:  
Bound 8 x 10" notebook with cross-lined and removable duplicate pages.
- Splash proof goggles (Must meet ANSI Z87 specifications)
- Scientific calculator

## Grade Calculation

Grades will be tentatively based on a 90/80/70/60 scale, but may be adjusted on my evaluation of the class.

Course grade will be determined by:

Lab Reports	80%
Lab Practices	20%



Generally five to six experiments are assigned during the semester. The instructor reserves the right to adjust this number if conditions warrant the deletion and/or the addition of exercises or reports.

All assigned experiments must be completed with submitted reports to receive a passing grade.

The lab practice grade includes technique, safety, professional attitude, work ethic, etc.

Periodically through the semester recitation or paper assignments will be made during the lab period. These will consist of a variety of exercise such as in depth problems, thought questions, literature searches, short presentations, etc. These are important learning opportunities.

## Safety Notice

Physical Chemistry students have a bad habit of believing that they are advanced chemists and no longer need to follow safety rules. **This is NOT TRUE.** PChem students must recognize that while their increased knowledge allows them to participate in laboratory exercises utilizing a wider array of chemicals, procedures, and equipment, these things carry increased risk and possibility for danger if used careless or incorrectly. Many of the experiments have the potential to cause serious injury if not performed correctly. Students are expected to utilize safe lab practices and abide by all Departmental safety policies. (Found on Pages 8-11 of this document.) **Safety goggles must be worn in the laboratory at all times!!!** Goggles must be splash-proof (indirectly vented) and meet ANSI Z87 criteria.

Appropriate lab wear should be worn. This includes long pants or skirts and shirts with sleeves. Tank tops, tube tops, shirts with spaghetti straps, strapless shirts, sleeveless shirts and crop tops are all examples of inappropriate clothing. Closed toes shoes which fully encase the foot are also required. Students who come to lab inappropriately attired will be asked to leave.

Students must have a safety contract for the current semester on file with the Department prior to participating in the first laboratory exercise. Please see page 13. The safety contract may be found on the last page of this document.



## Tentative Schedule

**This is a tentative schedule of proposed experiments.** I reserve the right to alter the schedule and/or experiments performed as needed throughout the course of the term.

Students are expected to attend each week as making up missed labs is generally not feasible. However, I am aware that dates for visits and interviews with grad schools, professional schools, employers and the like are often out of students control. I will do my best to accommodate these types of absences if I am informed of them well in advance.

Date	Performing	Due
18 Jan	Literature Exercise	—
25 Jan	Diffusion Coefficient of KCl	Feb
1 Feb	Recitation	—
8 Feb	Kinetics	Feb
15 Feb	Recitation (Test Week)	
22 Feb	Universal Constants Lab	Mar
29 Feb	Recitation	—
7 Mar	Crystallography	Mar
14 Mar	SPRING BREAK	
21 Mar	Recitation	
28 Mar	Carbocyanine Dyes	Apr
4 Apr	Recitation	—
11 Apr	Vibrational -Rotational Spectra of HCl (by appointment)	Apr
18 Apr	Recitation	
25 Apr	Mystery Lab	—

## Preparation for Lab

Experimental procedures will be posted to Canvas prior to the lab period. Students are responsible for downloading and reading the materials prior to the lab period. See page 6 Course Responsibilities—Come Prepared for more information about the students' pre-lab responsibilities.



Students will need to submit a requisition list for each lab to Canvas by noon on Monday prior to the lab. The requisition should include all supplies (chemicals, equipment, glassware, ironware and incidentals needed to perform the experiment). Major pieces of equipment (IR, UV-Vis, etc) do not need to be requisitioned. Only requisitioned items will be provided. This list counts toward the lab practices portion of the course grade.

**GOOD  
MANNERS  
and  
KINDNESS  
ARE ALWAYS  
IN FASHION**

- This is an active classroom where students are encouraged interact with the instructor, teaching assistant and each other extensively. Students are asked to respect each other in their actions and speech. Derogatory remarks and profanity should be avoided. Students should take care to listen to and avoid interrupting or talking over others.
- The use of laptops, tablets, smartphones and is often necessary, but should (for the most part) be limited to uses related to class. Sharing of videos, music, *etc* is acceptable in downtimes so long as students remember the laboratory is a professional environment and content should be appropriate to such a setting. Questionable content should be avoided in class. (Please note this include wallpapers).
- When leaving the room, students are requested to inform the instructor or TA as a courtesy.
- This course includes large amounts of group work. Students are asked to participate appropriately by making every effort to stay on topic and respect time constraints, treating group members with dignity and respect and sharing the workload by neither shirking nor monopolizing. If a group is not working please let the instructor know.
- The laboratory can be an uncomfortable, and/or frustrating place as equipment breaks, procedures are change or experiments do not work. Please make every effort to keep expressions of chagrin, annoyance, aggravation, disgruntlement, dolefulness and exasperation appropriate for work. You are welcome to express such sentiments; just do so without vulgar language or personal attacks.
- **Students are expected to observe safe laboratory practices at all times.** Please see the Laboratory Safety Guidelines at the end of this document. Be advise that students creating a hazard in the laboratory will be asked to leave immediately.



## Academic Integrity

**Honor and integrity will not allow me to lie, cheat, or steal, nor to accept that actions of those who do.**

The value of any academic degree depends upon the integrity of the work done in earning the degree. Academic misconduct includes, but is not limited to cheating, plagiarism, collusion and/or falsification of records (including data). Students are expected to assume full responsibility for the content and integrity of all academic work submitted.

University policy obliges instructors to report cases of academic misconduct to the Dean of Students; it also obligates students to report observed instances of academic dishonesty to the instructor. As upper division students expect an extremely high level of responsibility and academic honesty from my PChem students.

Services such as Chegg, CourseHero, *etc* have contributed to blurring lines between acceptable use for tutoring and academic misconduct. Such services do provide some legitimate value, but care must be taken in using them. It is never appropriate to one of these services to provide lab reports or answers to discussion questions for you. **I never approve the posting of any of my course materials on these sites.**

Students with questions about the appropriateness material should be directed to the instructor before work is submitted. In this way they can be resolved before an academic integrity violation occurs.



**Students Experiencing Illness**

Students who are feeling ill or experiencing symptoms such as sneezing, coughing, digestive issues (e.g. nausea, diarrhea), or a higher than normal temperature should stay at home and are encouraged to stay home. Students who suspect they have been exposed to or tested positive for COVID should use the [UT Tyler COVID-19 Information and Procedures](#) website to review protocols, check symptoms, and report possible exposure.



Students are reminded that the spread of most communicable diseases can be reduced by using good health hygiene practices such as covering coughs and sneezes, frequent hand washing, surface cleaning and staying home when ill. Students are further encouraged to maintain a healthy immune system through practicing good self-care. College is stressful enough without getting sick!



Stay home if you feel sick.

**COVID Mitigation**

UT Tyler guidelines for COVID mitigation will be followed. Should the University mandate remote learning this class will shift to an online format. It is anticipated that will be Zoom sessions at the scheduled course time. Details will be provided on the course Canvas page in this event.

**Additional Accommodation**

Students needing additional accommodations may contact the Office of Student Accessibility and Resources at University Center 3150, or call (903) 566-7079 or email [saroffice@uttyler.edu](mailto:saroffice@uttyler.edu).

## Student Resources

- **Enrollment Services Center** (ADM 230). Visit to adjust majors, add/drop classes or get financial aid help. (Be prepared to wait during the first couple of weeks of the semester and around the "drop date".)
- **Student Counseling Center** ([www.uttyler.edu/counseling](http://www.uttyler.edu/counseling)). Available to help students deal with stress/anxiety, improve study skills, time management, *etc* (all confidential)
- **UT Tyler Student Health and Wellness** ([www.uttyler.edu/wellness](http://www.uttyler.edu/wellness)). Provides assistance with substance abuse, household violence, good eating habits, nutrition and exercise, *etc*.
- **Academic Success** ([www.uttyler.edu/success](http://www.uttyler.edu/success)). Manages Supplemental Instruction (SI), Student Learning Communities (SLC), and the tutoring center.
- **The Writing Center** ([www.uttyler.edu/writingcenter](http://www.uttyler.edu/writingcenter)). Ready to help writing skills and proofing.

## University Policies

The full list of University policies can be found on the course Canvas page and can be accessed via this weblink: [www.uttyler.edu/academicaffairs/syllabuspolicies.pdf](http://www.uttyler.edu/academicaffairs/syllabuspolicies.pdf)

Additional information about specific topics can be found:

Students Rights and Responsibilities - <http://www.uttyler.edu/wellness/rightsresponsibilities.php>

Campus Carry - <http://www.uttyler.edu/about/campus-carry/index.php>

UT Tyler a Tobacco-Free University- [www.uttyler.edu/tobacco-free](http://www.uttyler.edu/tobacco-free).

Grade Replacement/Forgiveness and Census Date Policies - <http://www.uttyler.edu/registrar>.

Disability/Accessibility Services - <https://hood.accessiblelearning.com/UTTyler> and <http://www.uttyler.edu/disabilityservices>

**Attend Class in Person.**

The course is conducted in person. Making up labs is extremely difficult so please make every effort to attend. Students will work both in dividually and in groups depending on the exercise. Groups may be subject to change throughout the term.

**Students must keep a record of their work in a lab notebook.**

This will be a complete record of all experiments performed. All prelab notes, procedures, data, calculations and observations should be written in either a physical or digital notebook. The data should be submitted to the instructor BEFORE leaving the class.

**Lab reports are required.**

A formal word-processed report is to be prepared and submitted (usually within two weeks) after each experiment unless stated otherwise. Late reports will be penalized with a letter grade (10%) deduction per day unless arrangements have been made with the instructor. Report grades will be based on formatting, completeness, clarity of presentation, experimental results, discussion of results and error, conclusions and understanding of the theory involved in the experiment. More information will be posted on the course Canvas page.

**Proper references are required.**

Reports are expected to include appropriate citations of procedures, reference values, physical constants, diagrams, theoretical backgrounds, data comparison and discussions. These references should be from high quality literature. Wiki references are not acceptable (anyone can edit that stuff!). All information obtained from a source (not from yourself ) must be referenced. ACS is the preferred citation style.

**Come prepared.**

Study the experiment and be familiar with the theory, apparatus, design and procedure before coming to lab. A requisition requesting all equipment and chemicals needed for the experiment must be submitted by noon on the Tuesday preceding the experiment. Quantities & sizes of glassware and volumes/masses of chemicals are mandatory information in the requisition. You will only be supplied with the items and chemicals you requisition.

**Take care of the equipment.**

Much of the equipment used in the laboratory is expensive and or/difficult to replace. Handle all equipment very carefully and leave it clean and in good condition. Report any damage to the instructor as soon as it occurs or is noticed.

**Work appropriately with your peers.**

When working individually, respect other students using the same equipment and supplies by keeping work areas tidy, cleaning equipment after use and equitably sharing equipment as needed. When working in teams actively contribute to the completion of the experiment. Students are encouraged to discuss the experiment outside of class. However, each individual must submit her/her own original lab report unless otherwise directed.

**Work responsibly.**

Conduct only authorized procedures and do so only after thoroughly reviewing the procedures. If you are unsure of how to properly conduct the experiment, seek clarification. Do not leave an active experiment unmonitored. Dispose of chemicals appropriately. Clean up after yourself.

**Do not plagiarize.**

Plagiarism and other forms of cheating will not be tolerated. University regulations are explicit about academic dishonesty and will be enforced. These regulations are contained in *A Student Guide to Conduct and Discipline at UT Tyler*, which may be obtained in the Office of Student Affairs or accessed at <http://www.uttyler.edu/mainsite/conduct.html>.

**Observe the Honor Code.**

In the laboratory, an honor code will apply under which students are to conduct the experiment to honestly collect and record data. Students are also to work alone in writing their laboratory reports and are not to copy material from any source without proper citation. Students are expected to help enforce this code.

**Purpose**

Chemistry is a hands-on laboratory class. You will be doing many laboratory activities, which require the use of hazardous chemicals. Safety in the chemistry laboratory is the number one priority for students, instructors, and assistants. To ensure a safe chemistry laboratory, a list of rules has been developed and provided to you in this student safety contract. These rules must be followed at all times. The student safety contract and signature page are provided to you and the signature page must be returned to the laboratory instructor before you can participate in the laboratory.

**General Guidelines**

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
3. Never work alone. No student may work in the laboratory without an instructor present.
4. When first entering a chemistry laboratory, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.
8. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Bring only your laboratory instructions, worksheets, and/or reports to the work area. Other materials (books, purses, backpacks, etc.) should be stored in the classroom area.
9. Keep aisles clear. Protect personal gear—backpacks, pocketbooks, briefcases, coats, etc.—by placing them in the lab drawers or other locations designated by the instructor.
10. Know the locations and operating procedures of all safety equipment including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Know where the fire alarm and the exits are located.
11. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
12. Be alert and proceed with caution at all times in the laboratory. Notify the instructor immediately of any unsafe conditions you observe.
13. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink. Check the label of all waste containers twice before adding your chemical waste to the container.
14. Labels and equipment instructions must be read carefully before use. Set up and use the prescribed apparatus as directed in the laboratory instructions or by your instructor.
15. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. **Wash your hands with soap and water after performing all experiments.**
16. Clean (with detergent), rinse, and wipe dry all work surfaces (including the sink) and apparatus at the end of the experiment. Return all equipment clean and in working order to the proper storage area.



17. Experiments must be personally monitored at all times. You will be assigned a laboratory station at which to work. Do not wander around the room, distract other students, or interfere with the laboratory experiments of others.
18. Students are never permitted in the chemistry storage rooms or preparation areas unless given specific permission by their instructor.
19. Know what to do if there is a fire drill during a laboratory period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
20. When using knives and other sharp instruments, always carry with tips and points pointing down and away. Always cut away from your body. Never try to catch falling sharp instruments. Grasp sharp instruments only by the handles.

### Clothing

1. Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. **There will be no exceptions to this rule!**
2. Contact lenses should not be worn in the laboratory unless you have permission from your instructor.
3. Dress properly during a laboratory activity. Long hair, dangling jewelry, and loose or baggy clothing are a hazard in the laboratory. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed.
4. Lab aprons are available, and you are encouraged to wear them to provide additional protection.

### Accidents and Injuries

1. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.
2. If you or your lab partner are hurt, immediately obtain the instructor's attention.
3. **If a chemical should splash in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.**

### Handling Chemicals

1. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for smelling chemical fumes will be demonstrated to you.
2. Check the label on chemical bottles twice before removing any of the contents. Take only as much chemical as you need.
3. Never return unused chemicals to their original containers.
4. Never use mouth suction to fill a pipet. Use a rubber bulb or pipet pump.
5. When transferring reagents from one container to another, hold the containers away from your body.
6. Acids must be handled with extreme care. You will be shown the proper method for diluting strong acids. Always add acid to water, swirl or stir the solution and be careful of the heat produced, particularly with sulfuric acid.
7. Handle flammable hazardous liquids over a pan to contain spills. Never dispense flammable liquids anywhere near an open flame or source of heat.
8. Never remove chemicals or other materials from the laboratory area.

9. Take great care when transferring acids and other chemicals from one part of the laboratory to another. Hold them securely and walk carefully.
10. **Solid materials are never allowed in the sinks!**
11. **Never discard liquids in the sinks unless specifically indicated by your instructor!**
12. Pay particular attention to the waste disposal instructions specific to each experiment.

### Handling Glassware and Equipment

1. Carry glass tubing, especially long pieces, in a vertical position to minimize the likelihood of breakage and injury.
2. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
3. Inserting and removing glass tubing from rubber stoppers can be dangerous. Always lubricate glassware (tubing, thistle tubes, thermometers, etc.) before attempting to insert it in a stopper. Always protect your hands with towels or cotton gloves when inserting glass tubing into, or removing it from, a rubber stopper. If a piece of glassware becomes "frozen" in a stopper, take it to your instructor for removal.
4. Fill wash bottles only with distilled water and use only as intended, e.g., rinsing glassware and equipment, or adding water to a container.
5. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
6. Examine glassware before each use. Never use chipped or cracked glassware. Never use dirty glassware.
7. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.
8. If you do not understand how to use a piece of equipment, ask the instructor for help. 9.

Do not place hot glassware in cold water or on cold surfaces; it may shatter.

### Heating Substances

1. Exercise extreme caution when using a gas burner. Take care that hair, clothing, and hands are a safe distance from the flame at all times. Do not put any substance into the flame unless specifically instructed to do so. Never reach over an exposed flame. Light gas (or alcohol) burners only as instructed by the teacher.
2. Never leave a lit burner unattended. Never leave anything that is being heated or is visibly reacting unattended. Always turn the burner or hot plate off when not in use.
3. You will be instructed in the proper method of heating and boiling liquids in test tubes. Do not point the open end of a test tube being heated at yourself or anyone else.
4. Heated metals and glass remain very hot for a long time. They should be set aside to cool and picked up with caution. Use tongs or heat-protective gloves if necessary.
5. Never look into a container that is being heated.
6. Do not place hot apparatus directly on the laboratory desk. Always use an insulating pad. Allow plenty of time for hot apparatus to cool before touching it.
7. When bending glass, allow time for the glass to cool before further handling. Hot and cold glassware have the same visual appearance. Determine if an object is hot by bringing the back of your hand close to it prior to grasping it.

UT-Tyler Department of Chemistry & Biochemistry  
Safety Contract

Name: \_\_\_\_\_

Course &amp; Sec.: Chem 3155-001

Student ID Number: \_\_\_\_\_

Semester: Spring 2021

- I. Are you color blind?  YES  NO  
Do you intend to wear contact lenses during lab?  YES  NO

I hereby release the Department of Chemistry & Biochemistry at The University of Texas at Tyler and its agents from any responsibility for any injury to my person or damage to my contact lenses as a result of wearing contact lenses in the laboratory. I understand and agree to these special regulations.

Student Initials: \_\_\_\_\_

- II. List any specific allergies (if none, enter NONE):

\_\_\_\_\_  
\_\_\_\_\_

List any other medical conditions about which your instructor might need to inform emergency service personnel.

\_\_\_\_\_

Student Initials: \_\_\_\_\_

**Agreement**

I have read and agree to follow all of the safety rules set forth in this contract. I have viewed the *Laboratory Safety Training for Students* presentation and have achieved a score of 80% or better on the *Student Lab Safety Test*. I realize that I must obey these rules to ensure my own safety, and that of my fellow students and instructors. I will cooperate to the fullest extent with my instructor and fellow students to maintain a safe lab environment. I will also closely follow the oral and written instructions provided by the instructor. I am aware that any violation of this safety contract that results in unsafe conduct in the laboratory or misbehavior on my part, may result in being expelled from the laboratory, receiving a failing grade, and/or dismissal from the course.

Student Lab Safety Test Score \_\_\_\_\_

Date: \_\_\_\_\_

Student Signature: \_\_\_\_\_

Date: \_\_\_\_\_