| LSC Use Only Proposal No: | UWUCC Use Only Proposal No: 11-125b. |
|---|---|
| LSC Action-Date: AP-3/22/12 | UWUCC Action-Date: App-4/3/12 Senate Action Date: App-9/11/12 |

**Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee**

| Contact Person(s) **Sharon Sowa** | Email Address **ssowa@iup.edu** |
|---|---|
| Proposing Department/Unit **Chemistry** | Phone 74481 |

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

**1. Course Proposals (check all that apply)**

_____ New Course _____ Course Prefix Change _____ Course Deletion

__X__ Course Revision _____ Course Number and/or Title Change __X__ Catalog Description Change

*Current course prefix, number and full title:* CHEM 102 College Chemistry II

*Proposed course prefix, number and full title, if changing:*

**2. Liberal Studies Course Designations, as appropriate**

__x__ This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

_____ Learning Skills __X__ Knowledge Area _____ Global and Multicultural Awareness _____ Writing Intensive (include W cover sheet)

_____ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

_____ Global Citizenship _____ Information Literacy _____ Oral Communication

_____ Quantitative Reasoning _____ Scientific Literacy _____ Technological Literacy

**3. Other Designations, as appropriate**

_____ Honors College Course _____ Other: (e.g. Women's Studies, Pan African)

**4. Program Proposals**

_____ Catalog Description Change _____ Program Revision _____ Program Title Change _____ New Track

_____ New Degree Program _____ New Minor Program _____ Liberal Studies Requirement Changes _____ Other

*Current program name:*

*Proposed program name, if changing:*

| 5. Approvals | Signature | Date |
|---|---|---|
| Department Curriculum Committee Chair(s) | | 2/27/12 |
| Department Chairperson(s) | | 2/23/12 |
| College Curriculum Committee Chair | | 3/8/12 |
| College Dean | | 3/12/12 |
| Director of Liberal Studies (as needed) | | 3/27/12 |
| Director of Honors College (as needed) | | |
| Provost (as needed) | | |
| Additional signature (with title) as appropriate | | |
| UWUCC Co-Chairs | Gail S Sechrist | 4/3/12 |

Received
MAR 27 2012
Liberal Studies

Received
MAR 12 2012
Liberal Studies

Part II.

**New Syllabus of Record**

**1. Catalog Description**

CHEM 102 College Chemistry II (3c-2l-4cr)

Prerequisites: CHEM 101

Fundamental principles and concepts of organic and biochemistry are studied. Deals primarily with structural features of organic compounds, the chemistry of functional groups, and practical examples and uses of organic compounds. The laboratory portion illustrates properties and reactions of representative organic compounds. Designed for selected majors within the College of Health and Human Services and to fulfill the Liberal Studies Natural Science Laboratory Sequence requirement.

**2. Course Outcomes**

**Objective 1:**
The students will understand the principles of organic chemistry and apply them to biomolecules.
**Expected Student Learning Outcomes 1 and 2:**
Informed and empowered learners.
**Rationale:**
Exams and homework assignments, as well as laboratory investigations will determine whether students understand the unique chemical bonding of carbon, organic functional groups and their chemical reactivity. The students will learn how the structure of organic molecules reflect biochemical function.

**Objective 2:**
The students will analyze biochemical processes in a qualitative and semi-quantitative manner.
**Expected Student Learning Outcomes 1 and 2:**
Informed and empowered learners.
**Rationale:**
Students will be able to recognize organic functional groups and predict trends in physical properties such as melting point and water solubility. Students will recognize the chemical structures and reactivity of certain functional groups as germane to biochemical function.

**Objective 3:**
The students will relate biochemical principles to practical applications in areas such as health and nutrition.
**Expected Student Learning Outcomes 2 and 3:**
Empowered and responsible learners.
**Rationale:**
Students will be able to evaluate critically the chemical rationale of cell biology. Students can use their quantitative and measurement skills to evaluate nutritional needs and medication choices/dosages. In the laboratory, students will gain an understanding of three-dimensional molecular structure, measuring the chemical reactivity of organic compounds, conducting and observing biochemical processes, and

practicing the safe handling of hazardous materials to prevent damage to themselves and the environment.

**3. Detailed Course Outline**

College Chemistry II is a multi-section course taught by a team of instructors. However, it is always coordinated so that students receive exposure to the same series of lecture topics and the same experiments. There are special sections of both lecture and laboratory designated for students in Nursing and Allied Health Professions as well as Food and Nutrition.

**Lecture Topics**

1 hr = one 50 minute lecture or 'academic hour'

1. Review of College Chemistry I — 1 hour
Brief review of chemical bonding, acid-base behavior, oxidation/reduction and intermolecular forces.

2. Saturated Hydrocarbons — 4 hours
Definition of organic chemistry and introduction to functional groups. Structures, formulas, names (nomenclature system) of alkanes and cycloalkanes. Physical properties of saturated hydrocarbons including water solubility, melting/boiling points and relationship to chemical composition/structure. Constitutional and geometric isomers. Chemical reactivities including combustion, halogenation. Applications including insecticides, global warming/loss of the ozone layer.

3. Unsaturated Hydrocarbons — 4 hours
Structures, formulas, names (nomenclature system) of alkenes and alkynes, aromatics. Physical properties of unsaturated hydrocarbons. Constitutional and geometric isomers. Chemical reactivities including addition, oxidation, polymerization, (aromatic) substitution. Practical applications/everyday uses including plastics, pharmceuticals, food additives (antioxidants).

Exam 1 — 1 hour

4. Alcohols, Phenols, Ethers and their Sulfur Analogues — 4 lectures
Structures, formulas, names (nomenclature system) of alcohols, phenols, ethers, and thiols. Physical properties. Chemical reactions including acid-base behavior, dehydration and oxidation. Practical applications/everyday uses including antiseptics, anesthetics, flavors.

5. Aldehydes and Ketones — 4 hours
Structures, formulas, names (nomenclature system) of aldehydes and ketones. Physical properties. Chemical reactions including oxidation and reduction, hemiacetal and acetal formation, hydrolysis. Practical applications/everyday uses including industrial solvents, metabolic byproducts.

Exam 2 — 1 hour

6. Carboxylic Acids, Esters and other Acid Derivatives — 4 hours
Structures, formulas, names (nomenclature system) of carboxylic acids, esters, anhydrides. Physical properties. Chemical reactions including acidity, esterification, saponification, hydrolysis. Importance of phosphate esters and anhydrides to biological reactions. Esters as flavor compounds and pain relievers.

7. Amines and Amides 4 hours

Structures, formulas, names (nomenclature system) of amines and amides. Physical properties. Chemical reactions including basicity of amines, synthesis and hydrolysis of amides. Practical applications/everyday uses, including the physiological effects of alkaloids and other amine drugs.

Exam 3 1 hour

8. Stereoisomerism 1 hour

Identification of chiral molecules, tetrahedral stereocenters. Optical activity of enantiomers. Chemical reactivity of enantiomers. Importance of enantiomers to synthetic drug molecules (side effects).

9. Carbohydrates 3 hours

Chemical structures of carbohydrates including mono-,di- and polysaccharides. Physical and chemical properties of carbohydrates, including stereochemistry. Biological and nutritional roles of carbohydrates. Structure/function relationships.

10. Lipids 3 hours

Chemical structures of lipids including fatty acids, triacylglycerols, phospholipids, sphingolipids, steroids, eiconasnoids, fat soluble vitamins. Physical and chemical properties of lipids. Biological and nutritional roles of lipids. Structure/function relationships. Structure and importance of biological membranes.

11. Proteins 4 hours

Chemical structures of amino acids. Peptide bond formation. Physical and chemical properties of proteins. Levels of protein structure. Protein denaturation. Biological and nutritional roles of proteins. Structure/function relationships.

12. Nucleic Acids 2 hours

Chemical structures of nucleic acids. Three-dimensional structures of DNA and RNA. The genetic code. Introduction to biotechnology and its importance.

Exam 4 1 hour

The final exam will occur during the final exam period.

**Laboratory Topics - One Laboratory Period for each Experiment**

Week:

1 Check-in; Laboratory Safety
2 Introduction to Organic Chemistry
3 Alkanes and Cycloalkanes: Structure & Nomenclature
4 Unsaturated Hydrocarbons: Structure & Nomenclature
5 Properties of Alcohols and Phenols
6 The Chemistry of Aldehydes and Ketones
7 Carboxylic Acids
8 Making Soap: The Saponification Reaction
9 Preparation of Aspirin and Other Esters
10 Carbohydrates: Structure and Properties
11 Quantitation of Starch by Spectrophotometry
12 Enzymes: Hydrolysis of Starch by Amylase

13 Amino Acids and Proteins
14 Check-out; final quiz

**4. Evaluation Methods**

The evaluation consists of the lecture grade as 75% of the course grade, while the laboratory component determines 25%. The lecture grade includes quizzes/homework (10-20%), hourly exams (55% - 70%), and the final exam (20-25%). The laboratory grade is based on lab reports (75 – 80%) and quizzes (20-25%). The student must earn 65% in the laboratory in order to pass the course.

**5. Example Grading Scale**

Final course grade is determined by the percentage of total points earned by the student in both lecture and laboratory.

A 90-100% B 80-89% C 70-79% D 60-69% F <60%

**6. Undergraduate Course Attendance Policy**

The University expects all students to attend class. The attendance policy for this course will be consistent with the Undergraduate Course Attendance Policy in the IUP Catalog.

**7. Required textbook(s) Supplemental Books, and Readings**
Required text: *Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life* Second Edition by Ira Blei and George Odian, W.H. Freeman and Co., New York, 2009 Media Update Edition

Note: Each chapter in the text contains a "picture of health" application that connects the topic to its importance in the human body.

Laboratory Manual: *College Chemistry II: Exploring Organic and Biochemical Reality* Department of Chemistry, Indiana University of Pennsylvania, 2011 (available at ProPacket) To provide a dynamic set of experiments with specific applications for our students, the teaching faculty has developed its own laboratory manual that is available at a local photocopy center at low cost.

Supplemental Readings: Nursing and Allied Health students are encouraged to consult other references such as current issues of professional journals (e.g. *RN, American Journal of Nursing*) for supplemental information. Nutrition, safety science and other majors may also be directed toward current journals in their discipline.

**8. Special Resource Requirements**

Students are expected to have their own scientific calculators and to purchase and wear safaety goggles that meet the ANSI standard in the laboratory.

Students are expected to study from the required text, and are encouraged to take advantage of supplemental learning aids that accompany the text, such as the chemportal tutorials and website 'pointers' that can direct them to learning aids.

**9. Bibliography**

*General Organic and Biological Chemistry*, 7th ed by Katherine Denniston, Joseph Topping and Robert Caret, McGraw Hill, New York, 2011

*General Organic and Biological Chemistry*, 2nd ed by Janice Gorzynski Smith, McGraw Hill, New York, 2012

*General Organic and Biological Chemistry*, Structures of Life, 4th ed by Karen C. Timberlake, Pearson Education, New York, 2013

*Math & Dosage Calculations for Healthcare Professionals*, 4th ed by Kathryn A. Booth, James E. Wahley, Susan Sienkiewicz, and Jennifer F. Palmunen, McGraw Hill, New York, 2012

*Student Solutions Manual for Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life* by Mark D. Dadmun, W.H. Freeman and Co., New York, 2009

*Study Guide for Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life* by Marcia L. Gillette, W.H. Freeman and Co., New York, 2009

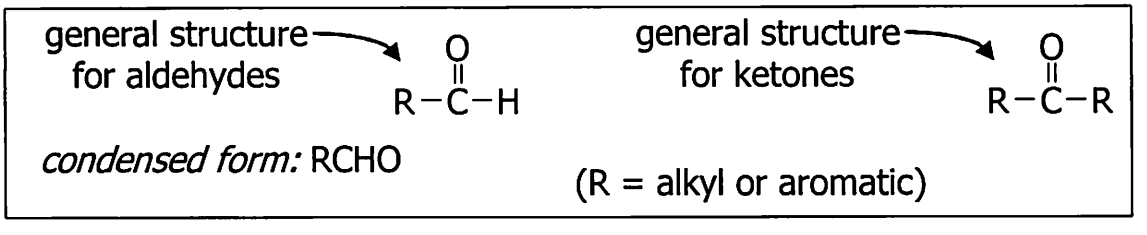
*www.whfreeman.com/bleiodian2e*: textbook website with online study aids, exercises, links to molecules in the news, etc

Sample Assignment CHEM 101: **Experiment 5**

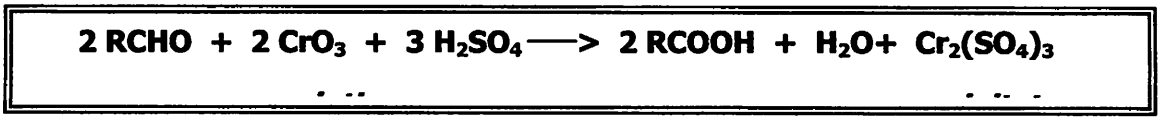
## THE CHEMISTRY OF ALDEHYDES AND KETONES

### Background

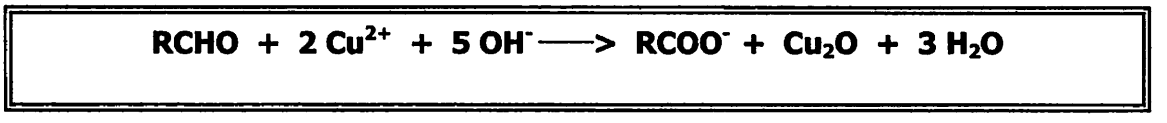
The carbon-oxygen double bond is called a **carbonyl** group. It is part of many important functional groups. Compounds that contain only the carbonyl group are called **aldehydes** or **ketones**. As can be seen by the formulas below, an aldehyde contains a carbonyl that is bonded to a hydrogen atom and an alkyl or aromatic group. The ketone carbonyl has two alkyl or aromatic groups attached to it.



Several reagents can be used for oxidation. The Jones' Reagent, which is a mixture of chromic acid and sulfuric acid produces a visible change in color. The mixture is initially a reddish color. If it reacts with an aldehyde, a blue-green precipitate of chromium (III) sulfate is formed as shown below. This reagent does not react with ketones or with glucose. It does, however, react with many alcohols. Why?



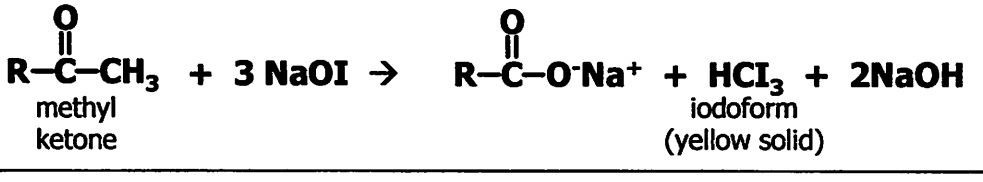

The Benedict's Reagent is a mild oxidizing agent that can be used to distinguish between some aldehydes and ketones, especially those that have an –OH group on the α-carbon (see page 415 of the textbook). When the aldehydes are oxidized the blue copper (II) ion is reduced. The solution goes from blue to muddy green and finally forms a red precipitate of copper (I) oxide. The reaction is shown below.



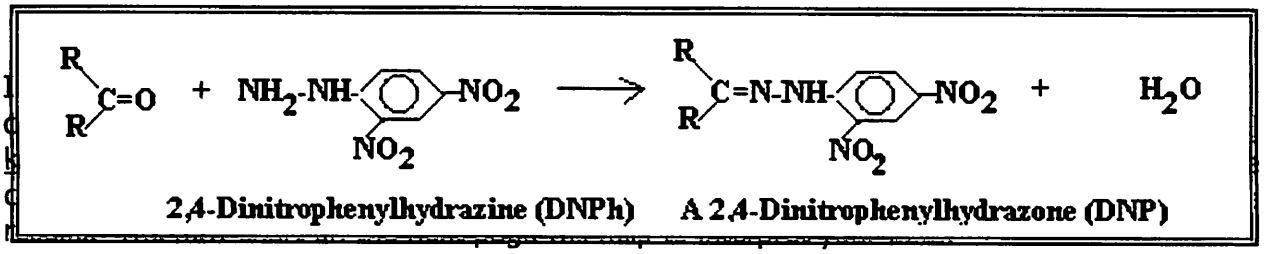

This reaction can be used to test for the presence of glucose in urine, a symptom of diabetes.

Some ketones have a methyl group attached to the carbonyl carbon. They are referred to as methyl ketones. Under the right conditions, these ketones can be oxidized to acids. One reagent that does this is sodium hypoiodide (NaOI) which can be formed from sodium hydroxide and iodine. One of the products is iodoform ($HCI_3$), a yellow solid with a medicinal odor, which precipitates out of solution. The reaction is shown below. Aldehydes do not react under these conditions (acetaldehyde is an exception).

The iodoform test for methyl ketones:



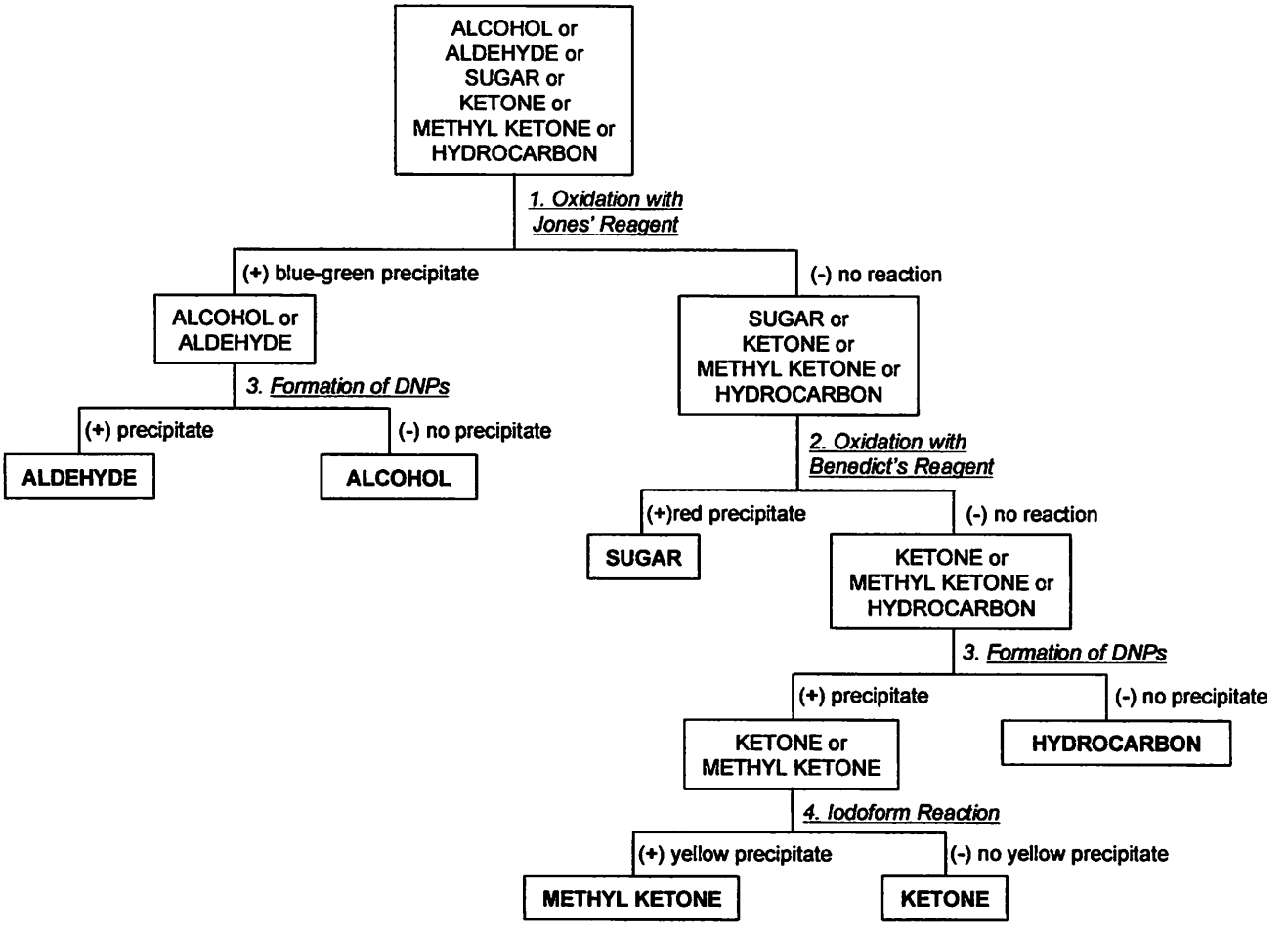

In the discussion above it has been pointed out several times that ethanol and/or other alcohols also give positive tests in these oxidation reactions. How does one differentiate between ketones and aldehydes and other functional groups? Several reactions do this. The one that is most frequently used is the reaction of 2,4-dinitrophenylhydrazine with the carbonyl group of ketones and aldehydes to form insoluble 2,4-dinitrophenylhydrazones (see the reaction below). Other functional groups do not react with this reagent in this manner. Thus, this reaction can be used to distinguish aldehydes and ketones from alcohols and from other carbonyl-containing functions.




**2,4-Dinitrophenylhydrazine (DNPh)** **A 2,4-Dinitrophenylhydrazone (DNP)**

**Flow Chart**

This chart shows how the four chemical tests (*1, 2, 3, and 4*) can be used to identify the 6 unknown samples. You start at the top and work down, performing the tests in order ONLY on those samples that need to be tested. First, test all 6 samples with Jones's reagent (test 1). Since only alcohols or aldehydes are + in this test, you should expect to have 4 negative samples. ONLY these 4 are then tested with Benedict's reagent (test 2). You should perform test 3 (formation of DNPs) only on 5 samples (you should have identified the sugar by test 2). Finally, you complete test 4 to distinguish the methyl ketone from the ketone.



## EXPERIMENTAL

YOU MUST WEAR SAFETY GOGGLES AT ALL TIMES IN THE LAB

**Many of the reagents used for this experiment contain strong acid or base.**

**If you spill any reagent on the lab bench, it must be neutralized and washed up.**

**NOTIFY YOUR INSTRUCTOR IMMEDIATELY FOR HELP.**

### TEST 1: Oxidation with Jones' Reagent

**Equipment**: 6 clean small test tubes, test tube rack

**Reagents**: 6 unknowns, dropper bottles of Jones' reagent and acetone

**Procedure**: *Make sure that all the test tubes that you use are clean.*

- ☐ Label the tubes, using the letters of the unknowns.
- ☐ Place about 10 drops of acetone in each one of the tubes.
- ☐ Add 1-2 drops of each unknown to the correct tube.
- ☐ Add 1 drop of Jones' Reagent to each tube and mix by shaking the tubes from side to side.
- ☐ Wait about 5 minutes and record your observations in Table 2 of the Data Sheet.
- ☐ Discard the contents of the tubes in the waste bottle in the hood.
- ☐ Wash the tubes and invert in the rack to drain.

### TEST 2: Oxidation with Benedict's Reagent

**Equipment**: 250 mL beaker, ring stand, 2 rings, wire gauze, Bunsen burner,

4 clean small test tubes, test tube rack, boiling chips

**Reagents**: 4 unknowns (only those that gave negative results with Jones' reagent),

dropper bottle of Benedict's reagent

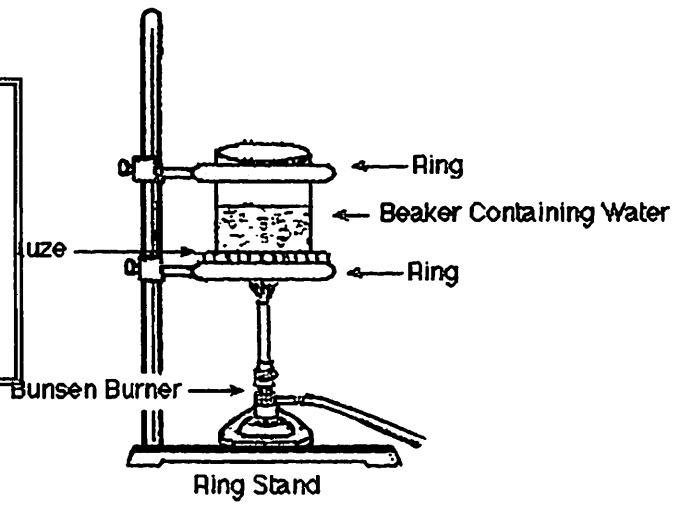
**Procedure**:

- ☐ Fill a **250 mL** beaker about halfway with water and add 3-5 boiling chips.

☐ Set up a water bath, as shown below, and heat it while you prepare the samples.

**CAUTION:**

SOME OF THE UNKNOWNS ARE FLAMMABLE. DO NOT WORK WITH OPEN BOTTLES NEAR THE FLAME.




☐ Label the test tubes with the letters of the unknowns to be tested.
☐ Put about 1 mL (20 drops) of Benedict's Reagent in each of the test tubes.
☐ Add 2-3 drops of each unknown to the correct tube. Shake from side to side to mix.
☐ Place the tubes in a beaker of boiling water for 10-15 minutes. *Keep an eye on the tubes – the label tape may fall off of the tubes in the water bath and you will need to keep track of the samples.*
☐ Record your observations in Table 2 of the Data Sheet. Glucose gives a red precipitate in this reaction.
☐ Discard the contents of the tubes in the waste bottle in the hood.
☐ Wash the tubes and invert in the rack to drain.

**TEST 3: Formation of DNPs (2,4-Dinitrophenylhydrazones)**

**Equipment**: 5 clean small test tubes, test tube rack

**Reagents**: 5 unknowns (all except the one identified as glucose), dropper bottle of DNPh reagent

**Procedure**:

☐ Label the test tubes with the letters of the unknowns to be tested.
☐ Add about 10 drops of DNPh reagent to each tube.
☐ Add 2-3 drops of each unknown to the correct tube. Mix by shaking from side to side.
☐ A yellow or orange precipitate is a positive test. Record your data in Table 3 of the Data Sheet.
☐ Discard the contents of the tubes in the waste bottle in the hood.
☐ Wash the tubes and invert in the rack to drain.

**TEST 4: Iodoform Reaction**

**Equipment**: 2 clean small test tubes

**Reagents**: 2 unknowns (the ketones), dropper bottles of 10% NaOH and iodine reagent

**Procedure**:

- ☐ Label the test tubes with the letters of the unknowns to be tested.
- ☐ Add 10 drops of 10% NaOH to each tube.
- ☐ Add 2-3 drops of unknown to the correct tube.
- ☐ Add about 1 mL (20 drops) of the iodine reagent. Shake to mix
- ☐ Allow to stand for about 10 minutes.
- ☐ If there is a precipitate, the test is positive. Note the color and the odor of the solid product. Record your observations in Table 3 of the Data Sheet.
- ☐ Discard the contents of the tubes in the waste bottle in the hood.
- ☐ Wash the tubes and invert in the rack to drain.

When you are finished working, clean your glassware and equipment and put it neatly in the drawer. Place the test tubes inverted in a beaker or rack so that they will drain completely. Wipe down your lab bench with a damp paper towel and wash your hands..

**PLEASE LEAVE THE LABORATORY, INCLUDING THE DRAWERS, IN THE SAME CONDITION YOU WOULD LIKE TO FIND IT!**

## Experiment 5 - THE CHEMISTRY OF ALDEHYDES AND KETONES

**Name** _____ **Date**_____

**Partner** _____ **Station #** _____ **Section** _____

### Pre-Lab Preparation

**1. Some or all of the six compounds below may be the unknowns in the experiment. Write the structures of these compounds in the boxes below. (You may have to look up the structure of glucose).**

| Hexane | Ethanol | Propanal |
|---|---|---|
| Cyclohexanone | Acetone (Propanone) | Glucose |

**2. Classify each compound as an alcohol, aldehyde, sugar, ketone, methyl ketone, or hydrocarbon**

| Hexane | Ethanol | Propanal |
|---|---|---|
| Cyclohexanone | Acetone (Propanone) | Glucose |

**3. Refer to the background information and answer the following:**

**(a) The reagent used to distinguish ketones and aldehydes from other functional groups is** _____.

**(b) Oxidation of an aldehyde produces a** _____.

**(c) A reagent used to diagnose diabetes is _____.**

**4. List two safety precautions, in addition to the one listed, that must be followed in this experiment.**

**(a) Wear goggles at all times in the laboratory.**

**(b)**

**(c)**

Sample Assessment: Grading Rubric for CHEM 102

Pre-Lab 10 points

Q 1 & Q2 - 6 points: 1 point each for a correct structure and classification
OR: 1/2 point for each correct structure and each correct classification
Q3 - 3 points: 1 point each for the identification of reagent/compound
Q4 - 1 point: is flammability and hazardous waste disposal mentioned as safety consideration(s)?

## Experiment 5 - THE CHEMISTRY OF ALDEHYDES AND KETONES

**Name** _____ **Date**_____

**Partner** _____ **Station #** _____ **Section** _____

### DATA SHEET

**NOTE:** There are 6 unknowns: a hydrocarbon, an alcohol, an aldehyde, two ketones (one of which is a methyl ketone) and a sugar (glucose). The chemical names of the unknowns will be written on the blackboard. Use these names to complete Table 1.

**Table 1.** Chemical classification and names of the unknowns

| Class of organic compound | Name of compound |
|---|---|
| hydrocarbon | |
| alcohol | |
| aldehyde | |
| ketone | |
| methyl ketone | |
| sugar | glucose |

**Table 2.** Results of oxidation with Jones'reagent (Test 1) and Benedict's reagent (Test 2).

| | JONES' REAGENT | BENEDICT'S REAGENT | |
|---|---|---|---|
| UNKNOWN | Observations* | Observations* | Conclusions** |
| A | | | |
| B | | | |
| C | | | |
| D | | | |

| | | | |
|---|---|---|---|
| **E** | | | |
| **F** | | | |

* For example, no reaction; changed color from orange to green; a solid precipitate formed, etc.

** Based on what you know about the 6 samples and the results of these tests (refer to the flow chart). For example, could be an alcohol or aldehyde, not an alcohol or aldehyde, a sugar, etc.

**Questions:**

1) Refer to the flow chart and give the **names** of the unknowns you expect to react with Jones' Reagent. Why?

2) In the oxidation with the Jones' Reagent, acetone (propanone) is used as the solvent.

Why can it be used in this reaction? Could ethanol be used as a solvent instead? Explain

**2. Table 3.** Results of Test 3 (Formation of DNPs) and Test 4 (Iodoform reaction). (NOTE: *Test 3 is to be performed on all of the unknowns except glucose. Test 4 is only performed on the two compounds identified as ketones by the earlier tests).*

| | **FORMATION OF DNPs** | **IODOFORM REACTION** | |
|---|---|---|---|
| **UNKNOWN** | **Observations** | **Observations** | **Conclusions** |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Questions:**

1) Refer to the flow chart and give the **names** of the unknowns you expect to react with DNPh reagent. Why?

2) Refer to the introduction and write the equation for the reaction of the unknown that reacted with the Iodoform reagent (use the structure of the unknown, not a general structure with R- groups).

Identify each of the unknowns tested in this experiment. Based on the results, write the **name** of each unknown in the table below.

| UNKNOWN | COMPOUND NAME |
|---|---|
| A | |
| B | |
| C | |
| D | |
| E | |
| F | |

**Questions:**

1) What test could be used to distinguish between each pair of compounds listed below?

Explain by indicating which compound would react and what you expect to observe.

(a) butanal and 2-butanone

(b) cyclohexane and cyclohexanol

(c) 1-hexanol and hexanal

(d) 3-pentanone and 2-pentanone

2) Many aromatic aldehydes are used as synthetic flavors. Another class of compounds that are used for this purpose are esters (RCOOR'). If you had a compound that smelled like bananas and you wanted to know if it were an aldehyde or an ester, what kind of test reaction would you run? What would you expect to observe.

3) Acetone is extremely soluble in water. Would you expect that 2-hexanone would also be very soluble in water? Explain by comparing the chemical structures of the two compounds (a diagram is useful).

**End of lab check-out form**

**Station # ___ is in good condition. Student initials _____ Instructor initials _____**

Sample Assessment: Grading Rubric for CHEM 102

Lab Report 25 points

Grading Checklist for Lab Report:

- The unknowns correctly listed and classified in table 1 (2 points)
- Does Table 2 contain correct observations and are appropriate conclusions drawn? (6 points)
- Is the correct explanation given in Q2 for not using ethanol as a solvent (all positive results)? (1 point)
- Does Table 3 contain correct observations and are appropriate conclusions drawn? (2 points)
- Q 2 contains a chemical structure (1 point)
- Are the unknowns correctly identified *by name* in the results table? (6 points)
- Are the answers to question 1 complete: is a distinguishing test described with the results clearly indicated? (4 points)
- Does the answer to question 3 provide an explanation for water-solubility ?(1 point)
- Did the student work safely - wearing goggles and cleaning up work areas? (2 points)

**End of sample Assessment**

Part II.
2. Summary of proposed revisions.

1. Revised course objectives to align with EUSLOs.
2. Updated laboratory schedule to include revised experiments.
3. Updated textbook edition and ancillaries.
4. Included sample laboratory experiment/report and grading rubric associated with Objectives2&3.

3. Justification/Rationale for the revision.

The course is a currently approved Liberal Studies Laboratory Natural Science course and is being revised to meet the new curriculum criteria for this category.

## Course Analysis Questionnaire

### Section A: Details of the Course

A1 How does this course fit into the programs of the department? For what students is the course designed? (majors, students in other majors, liberal studies). Explain why this content cannot be incorporated into an existing course.

**This course is intended for students enrolled in the Colleges of Health and Human Services and Natural Sciences and Mathematics. Some lecture and lab sections may be designed for Nursing and Allied Health majors and for Nutrition and Dietetics majors.**

A2 Does this course require changes in the content of existing courses or requirements for a program? If catalog descriptions of other courses or department programs must be changed as a result of the adoption of this course, please submit as separate proposals all other changes in courses and/or program requirements.

**No. No changes are required.**

A3 Has this course ever been offered at IUP on a trial basis (e.g. as a special topic) If so, explain the details of the offering (semester/year and number of students).

**No, this course was not offered on a trial basis.**

A4 Is this course to be a dual-level course? If so, please note that the graduate approval occurs after the undergraduate.

**No, this course is not dual-level.**

A5 If this course may be taken for variable credit, what criteria will be used to relate the credits to the learning experience of each student? Who will make this determination and by what procedures?

**This course is not taken for variable credit.**

A6 Do other higher education institutions currently offer this course? If so, please list examples (institution, course title).

**Higher ed institutions that have Nursing Programs offer comparable courses, e.g. in PASSHE Universities: Clarion (CHEM 152 Chemical Principles II), Mansfield (CHEM 1102 Introductory Organic and Biochemistry), and West Chester (CHE/CRL 107 – General Chemistry for the Allied Health Sciences).**

A7 Is the content, or are the skills, of the proposed course recommended or required by a professional society, accrediting authority, law or other external agency? If so, please provide documentation.

**No, this course is not required by a professional society, accrediting authority, law or other external agency.**

**Section B: Interdisciplinary Implications**

B1 Will this course be taught by instructors from more than one department? If so, explain the teaching plan, its rationale, and how the team will adhere to the syllabus of record.

**No, this course is taught by one instructor from the Chemistry Department.**

B2 What is the relationship between the content of this course and the content of courses offered by other departments? Summarize your discussions (with other departments) concerning the proposed changes and indicate how any conflicts have been resolved. Please attach relevant memoranda from these departments that clarify their attitudes toward the proposed change(s).

**There is no significant overlap between this course and courses offered by other departments.**

B3 Will this course be cross-listed with other departments? If so, please summarize the department representatives' discussions concerning the course and indicate how consistency will be maintained across departments.

**This course will not be cross-listed.**

**Section C: Implementation**

C1 Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this course will fit into the schedule(s) of current faculty. What will be taught less frequently or in fewer sections to make this possible? Please specify how preparation and equated workload will be assigned for this course.

**Faculty resources are adequate to teach this course.**

C2 What other resources will be needed to teach this course and how adequate are the current resources? If not adequate, what plans exist for achieving adequacy? Reply in terms of the following:

**Space, equipment, laboratory supplies and other consumable goods have been adequate to teach this course.**

C3 Are any of the resources for this course funded by a grant? If so, what provisions have been made to continue support for this course once the grant has expired? (Attach letters of support from Dean, Provost, etc.)

**This course is not grant-funded.**

C4 How frequently do you expect this course to be offered? Is this course particularly designed for or restricted to certain seasonal semesters?

**This course is offered every semester and during the summer.**

C5 How many sections of this course do you anticipate offering in any single semester?

**One to four lectures are offered each semester, depending on lecture room availability and lab capacity (typically 18 labs and 6 trailer lab sections).**

C6 How many students do you plan to accommodate in a section of this course? What is the justification for this planned number of students?

**Lecture sections range from 80-120 students. Labs are limited to 24 students.**

C7 Does any professional society recommend enrollment limits or parameters for a course of this nature? If they do, please quote from the appropriate documents.

**There are no professional society limitations on enrollment.**

C8 If this course is a distance education course, see the Implementation of Distance Education Agreement and the Undergraduate Distance Education Review Form in Appendix D and respond to the questions listed.

**Not applicable.**

## Section D: Miscellaneous

Include any additional information valuable to those reviewing this new course proposal.

**This course is an established Liberal Studies Natural Science Laboratory Course Elective. The reason for the course revision is to present the course objectives so that they apply to the LS EUSLO format.**

4. The old syllabus of record.

**SYLLABUS - CHEM 102**

I. **CATALOG DESCRIPTION** CHEM 102

**COURSE TITLE:** College Chemistry 2

**NUMBER OF CREDITS:** 3c-2l-4sh

**PREQUISITES:** CHEM 101

**COURSE DESCRIPTION:** Basic fundamental principles and concepts of organic and biochemistry are developed. Deals primarily with structural features of organic compounds, the chemistry of functional groups, and practical examples and uses of organic compounds. The laboratory portion illustrates properties and reactions of representative organic compounds. Designed for selected majors within the College of Health and Human Services and to fulfill the Liberal Studies Natural Science Laboratory Sequence requirement.

II. **COURSE OBJECTIVES**

The students are expected to understand the basic principles of organic chemistry, applying the concepts they learned in College Chemistry I to a new set of compounds that contain carbon. They are also expected to understand some of the basic relationships between molecular structure and biological function, i.e. biochemical principles, especially as they apply to everyday topics such as health and nutrition.

III. **DETAILED COURSE OUTLINE**

College Chemistry II is a multi-section course taught by a team of instructors. However, it is always coordinated so that students receive exposure to the same series of lecture topics and the same experiments. There are special sections of both lecture and laboratory designated for students in Nursing and Allied Health Professions as well as Food and Nutrition.

**A. Lecture Topics**

1. Review of College Chemistry I — 1 lecture

   Brief review of chemical bonding, acid-base behavior, oxidation/reduction and intermolecular forces.

2. Saturated Hydrocarbons — 4 lectures

Definition of organic chemistry and introduction to functional groups. Structures, formulas, names (nomenclature system) of alkanes and cycloalkanes. Physical properties of saturated hydrocarbons including water solubility, melting/boiling points and relationship to chemical composition/structure. Constitutional and geometric isomers. Chemical reactivities including combustion, halogenation.

3. Unsaturated Hydrocarbons — 4 lectures

Structures, formulas, names (nomenclature system) of alkenes and alkynes, aromatics. Physical properties of unsaturated hydrocarbons. Constitutional and geometric isomers. Chemical reactivities including addition, oxidation,polymerization, (aromatic) substitution. Practical applications/everyday uses.

4. Alcohols, Phenols, Ethers, and Their Sulfur Analogues — 4 lectures

Structures, formulas, names (nomenclature system) of. alcohols, phenols, ethers, and thiols. Physical properties. Chemical reactions including acid-base behavior, dehydration and oxidation. Practical applications/everyday uses.

5. Aldehydes and Ketones — 4 lectures

Structures, formulas, names (nomenclature system) of. aldehydes and ketones. Physical properties. Chemical reactions including oxidation and reduction, hemiacetal and acetal formation, hydrolysis. Practical applications/everyday uses.

6. Carboxylic acids, Esters, and Other Acid Derivatives — 4 lectures

Structures, formulas, names (nomenclature system) of carboxylic acids, esters, anhydrides. Physical properties. Chemical reactions including acidity, esterification, saponification, hydrolysis. Importance of phosphate esters and anhydrides to biological reactions.

7. Amines and Amides — 4 lectures

Structures, formulas, names (nomenclature system) of amines and amides. Physical properties. Chemical reactions including basicity of amines, synthesis and hydrolysis of amides. . Practical applications/everyday uses, including the physiological effects of

alkaloids.

8. Stereoisomerism — 1 lecture

Identification of chiral molecules, tetrahedral stereocenters. Optical activity of enantiomers. Chemical reactivity of enantiomers. Importance of enantiomers to synthetic drug molecules (side effects).

9. Carbohydrates — 3 lectures

Chemical structures of carbohydrates including mono-,di- and polysaccharides. Physical and chemical properties of carbohydrates, including stereochemistry. Biological roles of carbohydrates. Structure/function relationships.

10. Lipids — 4 lectures

Chemical structures of lipids including fatty acids, triacylglycerols, phospholipids, sphingolipids, steroids, eiconasnoids, fat soluble vitamins. Physical and chemical properties of lipids. Biological roles of lipids. Structure/function relationships. Structure and importance of biological membranes.

11. Proteins — 4 lectures

Chemical structures of amino acids. Peptide bond formation. Physical and chemical properties of proteins. Levels of protein structure. Protein denaturation. Biological roles of proteins. Structure/function relationships.

12. Nucleic acids — 2 lectures

Chemical structures of nucleic acids. Three-dimensional structures of DNA and RNA. The genetic code. Introduction to biotechnology and its importance.

**B. Laboratory Topics – 1 Laboratory Period for Each Experiment**

1. Laboratory Safety: Organic and Biochemicals
2. Alkanes and Cycloalkanes: Structure and Nomenclature
3. Using Molecular Models to Explore the Structure of Unsaturated Hydrocarbons
4. Properties of Alcohols and Phenols
5. The Chemistry of Aldehydes and Ketones
6. Carboxylic Acids
7. Making Soap: The Saponification Reaction
8. Preparation of Aspirin and Other Esters
9. Thin Layer Chromatography of Analgesics
10. Carbohydrates: Structure and Properties

11. Amino Acids and Proteins
12. Titration of a Water-Soluble Vitamin: The Vitamin C Content of Fruit Juice

## IV. EVALUATION METHODS

The evaluation consists of quizzes/homework, hourly exams, weekly lab reports and the final exam. Usually the lecture grade determines 75% of the final grade, while the laboratory component determines one-fourth. The final exam grade usually contributes 20-25% to the lecture grade, and hourly exam grades and homework/quizzes make up the rest. The laboratory grade is based on lab reports and quizzes.

Final course grade is determined by the percentage of total points earned by the student in both lecture and laboratory. The percentage is the total number of *points earned by the student* divided by the *total number of points* possible:

A $\geq$ 90%

B $\geq$ 80%

C $\geq$ 70%

D $\geq$ 60%

F < 60%

## V. REQUIRED TEXTBOOK(S)

*Chemistry: General, Organic and Biochemistry, Connecting Chemistry to Your Life* by Ira Blei and George Odian, W.H. Freeman and Co., New York, 2000

Note: Each chapter in the text contains a "picture of health" application that connects the topic to its importance in the human body.

Laboratory Manual: *College Chemistry II: Exploring Organic and Biochemical Reality* by Ruiess Ramsey and Sharon Sowa, Department of Chemistry, Indiana University of Pennsylvania, 2002 (available at ProPacket)

To provide a dynamic set of experiments with specific applications for our students, the teaching faculty has developed their own laboratory manual that is available at a local photocopy center at low cost.

## VI. SPECIAL RESOURCE REQUIREMENTS

Students are expected to have their own scientific calculators and to purchase and wear safety goggles that meet the ANSI standard in the laboratory.

Students are expected to study from the required text. Students are encouraged to take advantage of supplemental learning aids that accompany the text, such as the CD-ROM study-aid included that can also direct them to websites that provide learning aids for chemistry. Nursing and Allied Health students are encouraged to consult other references such as current issues of professional journals (e.g. RN, American Journal of Nursing) for supplemental information.

## VII. BIBLIOGRAPHY

There is a *Student Solutions Manual* available for the text, as well as a *Study Guide*; both are not required but might be helpful to the student. There are also learning aids available online at the *Website* for the text.

1. This is a multi-section, multi-instructor course that has separate sections for Nursing/Allied Health majors and also Food&Nutrition majors. All sections use the same laboratory manual, and the lab experiments closely correlate with lecture topics. Course instructors participate in a 'College Chemistry Teaching Circle' through CTE. A course coordinator is assigned to College Chemistry I and II. There is a department guideline standard evaluation procedure for all sections that requires a student to earn 65% in the laboratory portion of the course in order to pass.

2. Perspectives and contributions by women and ethnic minorities in chemistry are historic: Madam Curie's discovery of radiation, Markovnikov's Rule, the periodic table described by Mendeleev, the foundation of organic chemistry by Frederich Wohler, etc. These landmark scientists and others are mentioned in the text and not overlooked by instructors.

3. The exception to non-textbook work is made by the quantitative nature of the course in both lecture (topics such as measurements, dimensional analysis, stoichiometry) and laboratory. Students are required to use calculators for complex algebraic problem-solving and for logarithmic functions (pH).

4. This is an introductory course. It serves as a basic foundation of knowledge that can be applied to specific fields such as nursing or nutrition, and also applies to human health in general. It differs from Organic and Biochemistry in terms of depth of coverage, for example in terms of nomenclature and detail of reaction mechanisms as well as complexity of calculations.