CHEM 442 SPRING 2015

version 1.0 posted FEB 23 at 10am…
tentative test dates:

test one: W Jan 28 (50 points, your review of C1-C11)
test two: W Feb 25; 100 points; (date could change but probably won’t)
test three: W Apr 1; 100 points; (date could change but probably won’t)
test four: W Apr 29; 100 points; (date could change but probably won’t)
final exam: Friday, May 15, 2015 at 12:30pm; 100 points

twitter address:

http://www.twitter.com/chem442bausch

I will make every effort to make our twitter account useful…if I do it right, the document you’re looking at right now WILL NOT change much…I will try to make it all work through twitter.

Your first test will include questions from material contained within the first eleven chapters…

Lecture 1:00-1:50 pm; Neckers 440

*ANNOUNCEMENTS REGARDING EXAM DATES & SYLLABUS CHANGES WILL BE MADE PRIOR TO THE START OF LECTURES...IT IS THEREFORE TO YOUR ADVANTAGE TO ATTEND CLASS

+ INSTRUCTOR: Mark Bausch
+ OFFICE: Neckers 293
+ OFFICE HOURS: Monday & Wednesday mornings noon – 1pm (or make an appointment in person)

MATERIAL COVERED from text for the lecture portion of CHEM 442 (i.e. approximate schedule):
Refer to Table of Contents for a list of topics covered during the semester.
We’re starting with Chapter 14; we'll pick up any NMR that we need
EXAMINATION & GRADING SCALE INFORMATION

We will complete (at a minimum) discussion of Chapter 24 (amines)...if we have more time we will cover the chapter on polymers and materials chemistry
*all of the exam questions are multiple choice;
you will turn in only the scantron (name and dawgtag)...
you get to keep the sheet with the exam questions.
Circle your answers on that sheet with your answers to the questions...
I will post the answers on our twitter account a day or two after the exam.
You should therefore 'grade your own test'...and I ask that you keep track of your own
scores.
It is likely that I will not post the scores anywhere online.

*there are 50 points possible on Test 1
*there are 100 points possible on Tests 2, 3 and 4...you get to drop your lowest score of
these three points
*there are 100 points possible for the comprehensive final examination
*there are therefore 350 total points possible in this course
*Approximate scale (% basis out of total points possible): 85%, 75%, 65%, 55% (A, B,
C, D, respectively)
*Everyone who is registered for the course will receive a letter grade.

NOTES and SUGGESTIONS
*The very best time and place to talk with me about CHEM 442 is before, during and
after class, in and around Neckers 440...
and in my office during posted office hours.
*In general, no make-ups for missed exams are allowed.
*If you must miss an exam it is essential that you contact me prior to the exam IN
PERSON.
See me in person...please...for all issues related to this course; because of privacy issues
NO email
*E-MAIL NOTIFICATION OF EXAM-RELATED EXCUSES IS NOT SUFFICIENT...
YOU MUST CONTACT ME IN PERSON...
*It is essential that students arrive on time for lectures & exams...
students arriving late for exams may not be allowed to take the exam (instructor's
discretion)...
*Please be considerate and respectful of your fellow classmates...
do NOT consume food or drink in NECKERS 440 during classtime.
Also, turn off all cell phones. Please treat our lectures at least as well as you treat movies.
*Suggestion #1: Bring your textbook to class...and then, when studying, rely heavily on
your textbook as, during lecture, we will strive to utilize the textbook. Read upcoming
section(s) prior to their discussion in class...and be sure to bring your textbook to class
*Suggestion #2: Study a lot... purchase a spiral notebook for the problems within the
textbook...and fill up that notebook with your hard work. Also consider making an
outline of each chapter and incorporating that outline into your spiral notebook. Bring
your work to office hours.
*Suggestion #3: Repeat suggestion #2
*Suggestion #4: Ask questions when necessary. Good luck!
*Suggestion #5: Get connected with other CHEM 442 students for occasional group
study sessions
Emergency Procedures: SIUC is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with the SIUC Emergency Response Plan and Building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT's website at www.bert.siu.edu, Department of Safety's website www.dps.siu.edu (disaster drop down) and in Emergency Response Guideline pamphlet. Know how to respond to each type of emergency.

Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.
Old Test One (not the same as our Test One will be in that our Test One will only cover material from Chapters 1-11)

The neutral molecule $\text{CH}_2\text{O}$ contains how many sigma bonds?  (a) 1; (b) 2; (c) 3; (d) 4  (p 15)

How many equivalent resonance structures can be drawn for the carbonate anion ($\text{CO}_2^-$)?  (a) 1; (b) 2; (c) 3; (d) 4  (p 47)

The molecule isopropylbenzene contains how many carbon atoms that are bonded to exactly one hydrogen atom?  (a) 4; (b) 5; (c) 6; (d) 7  (p 85, C-15)

Which of the following cycloalkanes suffers from the most torsional strain?  Worded differently, which has the most significant eclipsing interactions?  (a) cyclopropane; (b) cyclobutane; (c) cyclopentane; (d) cyclohexane  (p 116)

Which of the following statements is true about meso compounds?  (a) they contain chiral centers and are optically active; (b) they contain chiral centers and are optically inactive; (c) they do not contain chiral centers and are optically active; (d) they do not contain chiral centers and are not optically active  (sec 5.7)

When HBr is allowed to react with ethene (and no other reagents), the reaction takes place in two steps.  The intermediate in this reaction is a…  (a) carbon anion; (b) carbon-centered radical; (c) carbocation  (p 205)

The characteristic reactions of alkenes are…  (a) addition reactions; (b) substitution reactions; (c) rearrangement reactions; (d) elimination reactions  (C-7,8)

Which of the following is the strongest Bronsted acid?  (a) butane; (b) 1-butene; (c) 2-butene; (d) 1-butene; (e) cis-1-butene  (C-7,8,9)

Consider the molecule cyclopentene.  Cyclobutene has vinylic hydrogens, allylic hydrogens, and alkyl hydrogens. Which C—H bonds are weakest (in a homolytic sense)?  (a) the vinylic C-H bonds; (b) the allylic C-H bonds; (c) the alkyl C-H bonds  (HINT: a vinylic hydrogen is a hydrogen bonded to a vinyl carbon, and so on) (p 351)

Which of the following statements about $\text{S}_\text{N}2$ reactions is not true?  (a) they proceed in one step; (b) their transition state is pentavalent; (c) they proceed with racemization; (d) their rates depend on the concentration of both the nucleophile and the electrophile  (C-11)

When 2-methyl-1,3-cyclohexadiene is allowed to react with HCl, three products form.  Which of the following is not one of those products?  (a) 3-chloro-3-methylcyclohexene; (b) 3-chloro-1-methylcyclohexene; (c) 4-chloro-1-methylcyclohexene; (d) 6-chloro-1-methylcyclohexene  (p 507)

A given reaction forms two different products (A and B).  At high temperatures, A is the primary product.  At low temperatures, B is the primary product.  If the reaction is carried out at high temperature (forming mostly A), it is correct to say that the reaction is...  (a) kinetically controlled; or (b) thermodynamically controlled  (sec 14.3)

When 1,3-cyclopentadiene is allowed to react with maleic anhydride, a Diels-Alder reaction ensues.  The product of this reaction contains how many carbon atoms that are bonded to exactly one hydrogen atom?  (a) 4; (b) 5; (c) 6; (d) 7; (e) 8  (p 512)

The C-H framework of an organic molecule can be studied best with the aid of which of the following techniques?  (a) mass spectroscopy; (b) IR spectroscopy; (c) NMR spectroscopy; (d) UV spectroscopy  (p 517)
FILL IN THE BLANK: Molecular orbital calculations show that the energy difference between the HOMO and LUMO in alkenes _______ as the extent of conjugation increases.  (a) increases; (b) decreases; (c) stays the same  (p 520)

A photon from which of the following regions of the electromagnetic spectrum has the shortest wavelength?  (a) infrared; (b) visible; (c) ultraviolet; (d) X-rays  (p 518)

Hydrogenating benzene (forming cyclohexane) is an exothermic reaction. The aromatic nature of benzene is used to explain the fact that… (a) the amount of heat given off when benzene is hydrogenated is more than might be expected; or (b) the amount of heat given off when benzene is hydrogenated is less than might be expected  (HINT: these expectations are based on heats of reaction for cyclohexene and 1,3-cyclohexadiene)  (p 539)

Which of the following is aromatic?  (a) cycloheptatrienyl cation; (b) cycloheptatrienyl radical; (c) cycloheptatrienide anion  (p 545)

When 1,3,5,7-cyclooctatetraene is allowed to react with potassium chloride, what happens?  (a) the aromatic cyclooctatetraene dianion forms; (b) the cyclooctatetraene dication forms; (c) there is no reaction  (p 546)

The unshared (lone) pair of electrons formally located on the nitrogen atom present in pyridine and pyrrole are found where? (a) both in pyridine and pyrrole--located in p orbitals; (b) both in pyridine and pyrrole--located in sp² orbitals; (c) in pyridine--p orbital & in pyrrole--sp² orbital; (d) in pyridine--sp² orbital & in pyrrole--p orbital  (p 546-7)

In the ^1^NMR spectra for benzene and ethene, the protons in benzene, relative to the protons in ethene, are… (a) deshielded and downfield (further left); (b) deshielded and upfield (further right); (c) shielded and downfield; (d) shielded and upfield  (p 552)

The characteristic reactions of benzene are… (a) addition reactions; (b) substitution reactions; (c) rearrangement reactions; (d) elimination reactions (C-16)

The organic intermediates in the benzene reactions we’ve studied thus far are… (a) carbocations; (b) carbon-centered radicals; (c) carbon anions  (p 569)

The reaction between 2-chloropropane and benzene, when catalyzed by AlCl₃, results in an organic product that contains how many carbon atoms that are bonded to exactly one hydrogen atom?  (a) 4; (b) 5; (c) 6; (d) 7  (p 575)

Did you benefit from our week-long review most of what you learned last semester?  (a) yes, a lot; (b) some; (c) a little; (d) not really
Old Test Two
Which of the following best describes the reaction(s) that occur(s) when nitrobenzene is allowed to react with a mixture of nitric and sulfuric acids? (a) the nitro- group in nitrobenzene retards the rate of reaction (compared to benzene) and the primary product that forms is 1,3-dinitrobenzene; (b) the nitro- group in nitrobenzene accelerates the rate of reaction (compared to benzene) and the primary product that forms is 1,3-dinitrobenzene; (c) the nitro- group in nitrobenzene retards the rate of reaction (compared to benzene) and the primary products that form are 1,2-dinitrobenzene and 1,4-dinitrobenzene; (c) the nitro- group in nitrobenzene accelerates the rate of reaction (compared to benzene) and the primary products that form are 1,2-dinitrobenzene and 1,4-dinitrobenzene  (p 581)
The -OH group in phenol, in electrophilic aromatic substitution (EAS) reactions, is considered to be a strongly activating group because… (a) it withdraws electrons via an inductive (sigma bond) effect; (b) it donates electrons via an inductive effect; (c) it withdraws electrons via a (p or pi) resonance effect; (d) it donates electrons via a (p or pi) resonance effect (p 584)
When chlorobenzene is allowed to react with a mixture of nitric and sulfuric acids…and the nitronium ion attacks para to the chlorine atom, one of the following resonance structures is not formed. Which one? The resonance structure with… (a) positive charge on chlorine; (b) positive charge on the carbon atom that the chlorine is bonded to; (c) positive charge on the carbon atom that is ortho to the carbon that the chlorine is bonded to; (d) positive charge on the carbon meta to the carbon that the chlorine is bonded to (p 588)
When o-nitrotoluene is allowed to react with Cl2 and a suitable Lewis Acid, which of the following does not form (or only forms in trace amounts)? (a) 2-chloro-6-nitrotoluene; (b) 4-chloro-2-nitrotoluene; (c) 5-chloro-2-nitrotoluene  (p 590)
When hydroxide, at 130°C, is allowed to react with 1-chloro-2-nitrobenzene, which of the following reaction mechanisms is most likely to occur? (a) S_N2; (b) S_N1; (c) EAS; (d) nucleophilic aromatic substitution (NAS)  (p 593)
You would expect benzyne itself (C6H4) to be highly reactive in which type of organic reaction? (a) elimination reactions; (b) substitution reactions; (c) addition reactions (p 595)
What is the molecular formula for the C6H5-containing (i.e. aromatic) product that results when butylbenzene is allowed to react with KMnO4 (in H2O)? (a) C7H6O2; (b) C7H5O2; (c) C7H6O; (d) C7H5O; (e) C7H5O  (p 596)
N-Bromosuccinimide (NBS), when allowed to react with propylbenzene in the presence of benzoyl peroxide and CCl4 solvent, forms (1-bromopropyl)benzene. The bromine intermediate in this reaction is in the form of a… (a) bromide ion; (b) bromine atom; (c) bromine cation  (p 598)
If you desire to prepare 4-bromo-2-nitrotoluene from benzene, you have to carry out three successive EAS reactions. Which of the following reactions should be the last of the three reactions? (a) the Friedel-Crafts methylation; (b) the Lewis Acid-catalyzed bromination; (c) the nitration with sulfuric and nitric acids  (p 602)
Simple alcohols such as ethanol are… (a) good hydrogen-bond donors and good hydrogen-bond acceptors; (b) poor hydrogen-bond donors and good hydrogen-bond
acceptors; (c) good hydrogen-bond donors and poor hydrogen-bond acceptors; (d) poor hydrogen-bond donors and poor hydrogen-bond acceptors (p 623)

In aqueous solution, which of the following is the weakest acid? (a) tert-butyl alcohol; (b) methanol; (c) phenol; (d) p-nitrophenol (p 625)

When methanol is allowed to react with sodium hydride, which of the following does not form? (a) sodium methoxide; (b) molecular hydrogen; (c) water (p 626)

When OsO₄ is allowed to react with simple cycloalkenes (such as cyclohexene), what forms? (a) aldehydes; (b) carboxylic acids; (c) cis 1,2-diols; (d) trans 1,2 diols (p 629)

NaBH₄ and LiAlH₄ are reagents often used in… (a) preparation of alcohols via oxidation of C=O bonds; (b) preparation of alcohols via reduction of C=O bonds; (c) preparation of alkanes via reduction of C=C bonds; (d) preparation of alkanes via oxidation of C=C bonds (p 631)

The organic part of the methyl magnesium iodide reagent is best thought of (in terms of its reactivity) as… (a) a methyl carbanion; (b) a methyl radical; (c) a methyl carbon anion (carbanion) (sec 17.5)

The organic part of the methyl magnesium iodide reagent is best thought of as… (a) a powerful nucleophile and a strong base; (b) a powerful nucleophile and a strong acid; (c) a weak nucleophile and a strong acid (sec 17.5)

When a simple tertiary alcohol is allowed to react with HCl, what forms? (a) a carboxylic acid; (b) a secondary alcohol; (c) a tertiary alkyl chloride; (d) an alkene (p 639)

When (R)-2-octanol is allowed to react with PBr₃ (in ether solvent), what forms? (a) (S)-2-bromooctane; (b) (S)-3-bromooctane; (c) (R)-2-bromooctane; (d) (R)-3-bromooctane (p 640)

In the mechanism of the acid-catalyzed dehydration of a tertiary alcohol to yield an alkene, the first significant intermediate formed… (a) has negative charge on oxygen; (b) has positive charge on oxygen; (c) has an oxygen-centered radical (p 642)

The molecule 2-propanol, when allowed to react with Na₂Cr₂O₇ (in water mixed with acetic acid, with a bit of heat), is transformed into a molecule whose molecular formula has how many hydrogen atoms? (a) 8; (b) 7; (c) 6; (d) 5; (e) 4 (p 646)

The molecular formula for chlorotrimethylsilane contains how many hydrogen atoms? (a) 9; (b) 10; (c) 11; (d) 12 (p 648)

Simple trimethylsilyl ethers are converted into simple alcohols by allowing them to react with… (a) hydroxide; (b) hydronium; (c) bromide anion; (d) sodium hydride (p 649)

Phenol, when allowed to react with Na₂Cr₂O₇ in water, is transformed into an organic molecule that contains how many hydrogen atoms? (a) 8; (b) 7; (c) 6; (d) 5; (e) 4 (p 653)

Simple ethers such as diethyl ether are… (a) good hydrogen-bond donors and good hydrogen-bond acceptors; (b) poor hydrogen-bond donors and good hydrogen-bond acceptors; (c) good hydrogen-bond donors and poor hydrogen-bond acceptors; (d) poor hydrogen-bond donors and poor hydrogen-bond acceptors (lecture)

Williamson ether syntheses (in which alkoxide anions are allowed to react with alkyl halides, forming ethers) are best thought of as… (a) E2 reactions; (b) E1 reactions; (c) Sₙ₂ reactions; (d) Sₙ₁ reactions (p 679)

Simple ethers (such as ethyl phenyl ether) are unreactive toward all of the following reagents except one. Which one? (a) halogens; (b) strong acids; (c) bases; (d) nucleophiles (sec 18.3)
The final step of the mechanism of the Claisen rearrangement (i.e. the heat-assisted conversion of allyl phenyl ether into \( o \)-allylphenol) is a(n)… (a) substitution reaction; (b) tautomerization; (c) addition reaction; (d) elimination reaction  (p 684, lecture)
The molecular formula for \( meta \)-chloroperoxybenzoic acid contains how many oxygen atoms? (a) 1; (b) 2; (c) 3; (d) 4  (p 685)
1,2-epoxycyclohexane, when allowed to react with hydronium, is transformed into… (a) \( cis \)-1,2-cyclohexanediol; (b) \( trans \)-1,2-cyclohexanediol; (c) cyclohexanol; (d) cyclohexene  (p 686)
Crown ethers are useful to organic chemists because of their ability to preferentially sequester (solvate) which of the following? (a) selected cations; (b) selected anions; (c) selected radicals  (p 691)
When a simple thiol is allowed to react with I₂, a disulfide forms. In this reaction, what is happening to the thiol? The thiol… (a) has been oxidized; (b) has been reduced; (c) is acting as a Bronsted base (p 692)
The molecule 2-ethyl-4-methylpentanal contains how many carbon atoms that are bonded to exactly one hydrogen atom? (a) 1; (b) 2; (c) 3; (d) 4 (p 723)
The total number of atoms in a single molecule of acetyl chloride is… (a) 5; (b) 6; (c) 7; (d) 8 (p 724)
Secondary alcohols, when treated with CrO₃, are transformed into… (a) carboxylic acids; (b) aldehydes; (c) ketones; (d) tertiary alcohols (p 726)
Simple aldehydes, when treated with CrO₃/H⁺, are transformed into… (a) primary alcohols; (b) secondary alcohols; (c) ketones; (d) carboxylic acids (p 727)
The characteristic reactions of aldehydes and ketones are… (a) elimination reactions; (b) substitution reactions; (c) nucleophilic addition reactions; (d) electrophilic addition reactions (p 728)
When water is allowed to react with acetone, the product that forms contains how many oxygen-hydrogen bonds? (a) 2; (b) 1; (c) 0; (d) 3 (p 731)
Simple cyanohydrins contain… (a) carbon, hydrogen and nitrogen only; (b) carbon, hydrogen, nitrogen and oxygen; (c) carbon, hydrogen and oxygen only; (d) carbon, nitrogen and oxygen only (p 733)
Which of the following, when allowed to react with CH₃MgI (followed by hydrolysis), is transformed into a primary alcohol? (a) acetone; (b) ethanal; (c) methanal (p 735)
When a primary amine is allowed to react with an aldehyde in the presence of an acid catalyst, an imine results. In the mechanism for this reaction, several intermediates are formed. Which of the following does not describe any of these intermediates in this mechanism? (a) one with formal negative charge on nitrogen; (b) one with formal positive charge on nitrogen; (c) one with formal negative charge on oxygen; (d) one with formal positive charge on oxygen (p 737)
Are the reaction velocities (i.e. kinetics) of imine formation (as described in 10 above) dependent on pH? (a) yes (b) no (p 739)
When 2-butanone is allowed to react with H₂NNH₂ & strong base, the organic product that forms contains how many hydrogen atoms? (a) 8; (b) 9; (c) 10; (d) 11 (p 741)
Cyclohexanone dimethyl acetal is what forms when cyclohexanone is allowed to react with two equivalents of methanol in the presence of HCl catalyst. How many carbon-oxygen bonds are there in cyclohexanone dimethyl acetal? (a) 2; (b) 3; (c) 4; (d) 5 (p 743)
What is the minimum number of carbon-oxygen bonds in a simple hemiacetal? (a) 2; (b) 3; (c) 4; (d) 5 (p 744)
A Wittig reaction is one in which an aldehyde/ketone reacts with a phosphorus ylide. A product of this reaction is a substance in which the C=O bond in the aldehyde/ketone is replaced with a… (a) a carbon-carbon single bond; (b) a carbon-carbon double bond; (c) a carbon-carbon triple bond (p 746)
Draw 2-cyclohexenone and correctly number the carbons in it. When Li(CH₃)₂Cu is allowed to react with 2-cyclohexenone, a new carbon-carbon bond is formed at which numbered carbon of 2-cyclohexenone? (a) #3; (b) #2; (c) #1; (d) #6 (p 754)
There are how many hydrogen atoms in the molecular formula for succinic acid? (a) 4; (b) 5; (c) 6; (d) 7; (e) 8 (p 780)

There are how many total atoms in the molecular formula for acetonitrile? (a) 6; (b) 5; (c) 4; (d) 7 (p 781)

Generally speaking, simple alcohols are… [(a) more acidic; or (b) less acidic]… than simple carboxylic acids because… (continued from 19.) …simple alkoxide anions are… [(a) more stable; or (b) less stable] than simple carboxylate anions. (p 783)

When Grignard reagents are allowed to react with CO_2 (followed by hydrolysis), what forms? (a) carboxylic acids; (b) ketones; (c) aldehydes; (d) secondary alcohols (p 790)

The dehydration of primary amides [RC(O)NH_2] results in the formation of simple nitriles. Which of the following is the reagent that enables this transformation? (a) hydroxide; (b) hydronium; (c) SOCl_2; (d) KMnO_4 (p 793)

Benzonitrile, when allowed to react with LiAlH_4 (and then water), is converted into a molecule with how many hydrogen atoms? (a) 8; (b) 7; (c) 6; (d) 5; (e) 9 (p 797)

The acidic -CO_2H proton in most carboxylic acids appears where in the proton NMR spectrum? (a) 3 ppm; (b) 12 ppm; (c) 7 ppm; (d) -2 ppm (p 799)

The molecular formula for acetamide contains how many hydrogen atoms? (a) 7; (b) 6; (c) 5; (d) 4 (p 816)

The alcoholysis of an acid chloride results in the formation of a(n)… (a) carboxylic acid; (b) ester; (c) amide; (d) aldehyde (p 821)

In the acid-catalyzed Fischer esterification of a carboxylic acid (in which the carboxylic acid react with an alcohol), what is the function of the acid catalyst? (a) to enhance the nucleophilicity of the carbonyl carbon of the carboxylic acid; (b) to enhance the electrophilicity of the carbonyl carbon of the carboxylic acid; (c) to enhance the nucleophilicity of the carbonyl oxygen atom of the carboxylic acid; (d) to protonate the carbonyl carbon atom of the carboxylic acid (p 825)

When carboxylic acids are allowed to react with LiAlH_4, what forms? (a) tertiary alcohols; (b) secondary alcohols; (c) primary alcohols (p 829)

When benzoyl chloride is allowed to react with cyclohexanol (in the presence of pyridine), cyclohexyl benzoate forms. How many hydrogen atoms are there in cyclohexyl benzoate? (a) 15; (b) 16; (c) 17; (d) 18 (p 831)

When benzoyl chloride is allowed to react with two equivalents of CH_3MgBr (followed by hydrolysis), what forms? (a) a tertiary alcohol; (b) a secondary alcohol; (c) a primary alcohol (p 833)

When esters are hydrolyzed via a base-induced mechanism, the organic intermediates are… (a) cations; (b) radicals; (c) anions (p 839)

Acid chlorides, when allowed to react with ammonia, are transformed into… (a) amines; (b) amides; (c) carboxylic acids; (d) aldehydes (p 843)

Nylon is an example of a… (a) polyamide; (b) polyester; (c) polyvinylchloride (p 848)
The keto-enol tautomerization process occurs in both acidic and basic media. Consider the following four statements and then choose…

i. in acid, the carbonyl oxygen is protonated  
ii. in acid, the carbonyl carbon is protonated  
iii. in base, a proton bonded to an ‘alpha carbon’ is removed  
iv. in base, the enolate anion that forms (via resonance) negative charge on both C and O

How many of statements i.-iv. are true? (a) 1; (b) 2; (c) 3; (d) 4 (p 872)

The concept of tautomerism helps explain the experimental observation that the alpha carbon atom in ethanal is… (a) electrophilic; (b) nucleophilic (p 874)

Ethanoic acid, when allowed to react with [ (1) PBr$_3$ and Br$_2$; (2) H$_2$O ], is transformed into an organic molecule that contains how many bromine atoms? (a) 0; (b) 1; (c) 2; (d) 3 (p 877)

Which of the following anions is the strongest base? (a) sodium fluoride; (b) sodium hydroxide; (c) lithium disopropyl amide; (d) tert-butyl lithium (p 878, lecture)

Which of the following is the strongest acid? (a) methane; (b) 2-propanone; (c) 2,4-pentanedione (p 879)

In order to prepare octanoic acid using a malonic ester synthesis, you would utilize diethyl malonate, sodium ethoxide, and what other organic molecule? (a) 1-bromobutane; (b) 1-bromopentane; (c) 1-bromohexane; (d) 1-bromooctane; (e) 1-bromononane (p 885)

Which of the following best describes what happens to β-ketoacids when heated? (a) they are protonated; (b) they are deprotonated; (c) they are carboxylated; (d) they are decarboxylated (p 886)

The formula for acetonitrile is CH$_3$CN. When acetonitrile is treated with LDA (in THF solvent), followed by methyl iodide, the molecular formula for the organic product that forms contains how many total atoms? (a) 9; (b) 11; (c) 10; (d) 12; (e) 8 (p 888)

The aldol condensation of acetaldehyde results in the formation of… (a) 2-hydroxybutanal; (b) 3-hydroxybutanal; (c) 4-hydroxybutanal (p 905)

When propanal is allowed to undergo aldol condensation, the organic product that forms is a… (a) substituted butanal; (b) substituted pentanal; (c) substituted hexanal (p 906, lecture)

Consider the double bonds in propenal and the double bonds in 1,3-butadiene, then consider the following two statements:

i. the double bonds in propenal are not conjugated  
ii. the double bonds in 1,3-butadiene are conjugated

Choose the best answer: (a) i. and ii. are both true; (b) i. and ii. are both false; (c) i. is true; ii. is false; (d) i. is false; ii. is true (p 909)

When butanal is treated with KOH in ethanol, the aldol condensation occurs and is generally followed by a dehydration. This final product (after dehydration) is… (a) 2-
ethyl-2-hexenal; (b) 3-ethyl-2-hexenal; (c) 4-ethyl-2-hexenal; (d) 2-ethyl-3-hexenal (p 911)

Mixed aldol condensations are best when how many of the two starting aldehydes contain acidic $\alpha$-protons? (a) 0; (b) 1; (c) 2 (p 912)

When 2,5-hexanedione is treated with NaOH in ethanol, the aldol product that forms is a cyclic structure that contains how many carbon atoms in the cycle? (a) 2; (b) 3; (c) 4; (d) 5 (p 914)

When ethyl propanoate is subjected to conditions leading to its Claisen condensation [(1) sodium ethoxide; (2) hydronium], the large organic product that forms contains how many oxygen atoms? (a) 2; (b) 3; (c) 4; (d) 5 (p 917)

Michael Reactions are described as Conjugate Carbonyl Additions that require a Michael Donor and a Michael Acceptor. These are important reactions because a new C-C bond is formed. Which of the following is a Michael Donor (i.e. nucleophile precursor) in a Michael Reaction? (a) propenal; (b) 2,4-pentanedione; (c) 3-buten-2-one; (d) propenamide (p 923)

When allowed to react with an enone such as 3-buten-2-one, enamines act as… (a) nucleophiles; (b) electrophiles (p 925)

The molecular formula for tert-butylamine contains how many hydrogen atoms? (a) 9; (b) 10; (c) 11; (d) 12; (e) 13 (p 945)

Consider the following two statements:

i. two trimethylamine molecules can hydrogen bond to each other
ii. trimethylamine can form hydrogen bonds with water
iii. two dimethylamine molecules can hydrogen bond to each other
iv. dimethylamine can form hydrogen bonds with water

How many of these statements are true? (a) 0; (b) 3; (c) 4; (d) 1 (p 948, lecture)

Which of the following amines is the weakest base? (a) pyrrole; (b) pyridine; (c) methylamine (p 950, lecture)

When a simple alkyl amine is in a mixture with a neutral compound such as a ketone, and both the amine and the ketone are dissolved in an organic solvent, the amine can be separated from the ketone by a sequence of reactions. The first step in this sequence of reactions is usually… (a) adding a dilute solution of HCl; (b) adding a dilute solution of NaOH; (c) distill off the organic solvent (p 951)

Would you expect 4-nitroaniline to be a stronger or weaker base than aniline? (a) stronger; (b) weaker (p 953)

Physiological pH is 7.3. Therefore, the formal charge on most amines (and the amino group in amino acids as well), at pH 7.3, is… (a) neutral; (b) negative; (c) positive (p 954, lecture)

When ethanal is allowed to react with methylamine and NaBH$_4$, the organic product that forms is… (a) trimethylamine; (b) ethylmethylamine; (c) propylamine; (d) dimethylamine (p 959)

Simple amides [RC(O)NH$_2$], when allowed to react with with NaOH, and Br$_2$ in water, are transformed into… (a) tertiary amines; (b) secondadry amines; (c) primary amines (p 960)