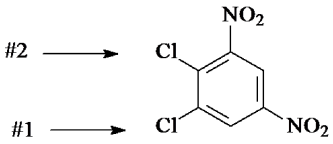
Name _____ Section _____
Chem 227 / Exam 3

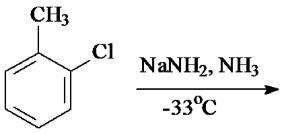
Questions #1-30: Answer on Scantron; multiple choice (4 pts. each); T/F (2 pts. each);
answer remaining questions on the exam, point values indicated. [Exam = 132 raw pts. total]

1. Which chlorine is most susceptible to nucleophilic substitution with $NaOCH_3$ in methanol?



A. #1 B. #2 C. #1 and #2 are equally susceptible. D. Substitution cannot occur.

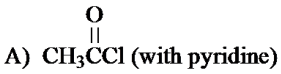
2. Identify the product(s) of the following reaction.

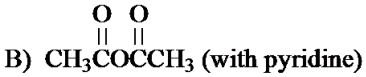


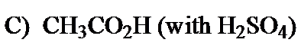
A. only *ortho*-methylaniline
B. *ortho*-methylaniline and *meta*-methyaniline
C. *meta*-methylaniline and *para*-methyaniline
D. *ortho*-methylaniline and *para*-methyaniline

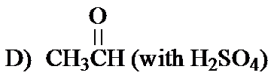
3. Which one of the following would <u>not</u> give butyl acetate when reacted with 1-butanol?

butyl acetate







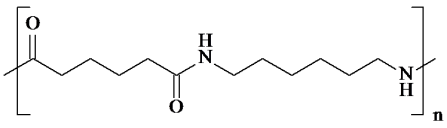


4. Arrange the following in order of decreasing acidity.

I. phenol II. *m*-nitrophenol III. *p*-nitrophenol

A. III > I > II
B. III > II > I
C. II > I > III
D. II > III > I

5. Identify the starting monomer(s) that can be used to make the following polymer.



Nylon

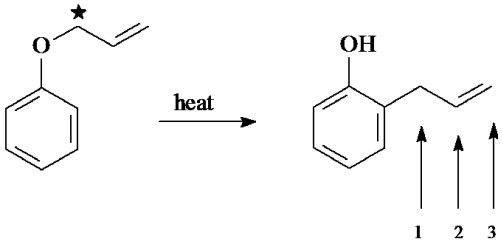
A) $HOC(CH_2)_4COH$ and $NH_2(CH_2)_6NH_2$

B) $H_2NC(CH_4)CNH_2$ and $HO(CH_2)_6OH$

C) $H_2N(CH_2)_5COH$

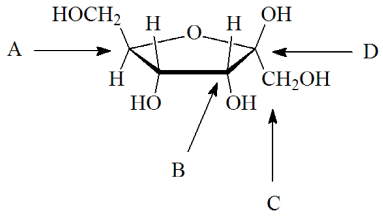
D) $NH_2C(CH_2)_5OH$

6. Indicate where the isotopically labeled carbon atom (*) is located in the product.



A. #1 B. #2 C. #3 D. equally distributed between #1 and #2

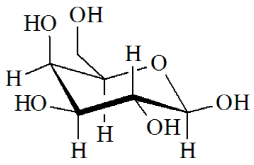
7. Identify the anomeric carbon in the following carbohydrate.

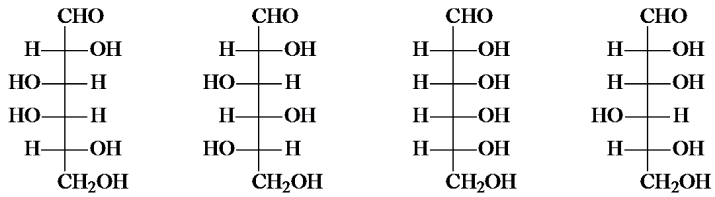


8. How many stereoisomeric (uncyclized) **D-**aldopentoses are there?

A) 2 B) 4 C) 8 D) 10 E) 16

9. Which of the following Fisher structures is the open-chain form of the pyranose chair conformation shown below?

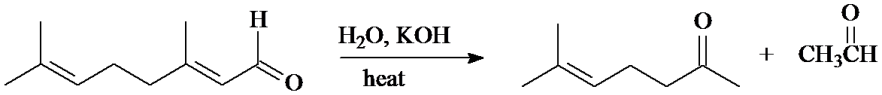




I II III IV

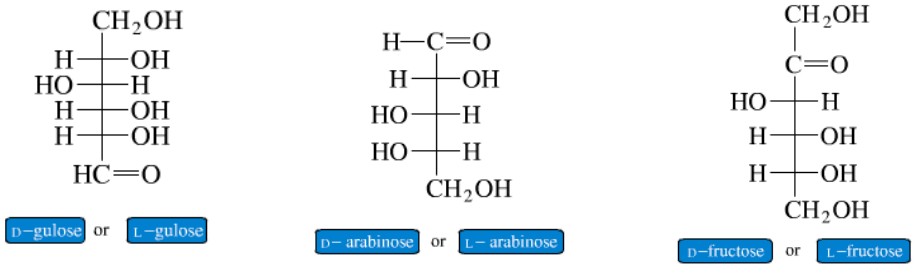
A. I B. II C. III D. IV

10. The monoterpene citral cleaves into two fragments, as shown below, when heated in aqueous base. Which of the following best describes the mechanism of this reaction?



A. retro-aldol
B. retro Diels-Alder
C. ozonolysis
D. hydrolysis

11. The stereochemical designations of the following monosaccharides are respectively:



A. L-gulose, L-arabinose, L-fructose
B. D-gulose, D-arabinose, L-fructose
C. D-gulose, L-arabinose, D-fructose
D. L-gulose, D-arabinose, L-fructose
E. L-gulose, L-arabinose, D-fructose

12. An amino acid has $pKa_1 = 3.6$, and $pKa_2 = 7.2$). Which of the following forms would prevail at pH = 5.4?

A. NH_2-CH(R)-COO-
B. H_2N-CH(R)-COOH
C. $+H_3N$-CH(R)-COOH
D. $+H_3N$-CH(R)-COO-

13. A pentapeptide was found to contain the amino acids ala, gly, met, phe, and ser. Partial hydrolysis of the pentapeptide gave the dipeptides gly-ser, met-phe, ala-gly, and ser-met. What is the sequence of the pentapeptide?

A. gly-ser-met-phe-ala
B. gly-ser-met-ala-phe
C. ala-gly-ser-phe-met
D. ala-gly-ser-met-phe

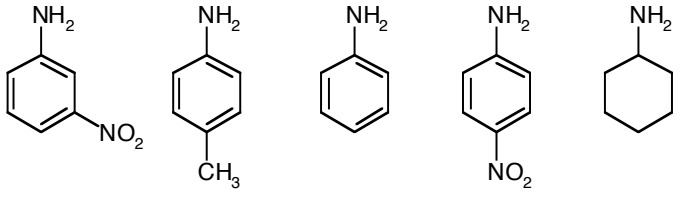
14. Naturally occurring unsaturated fatty acids have primarily

A. odd numbers of carbon atoms and *cis* double bonds.
B. even numbers of carbon atoms and *trans* double bonds.
C. even numbers of carbon atoms and conjugated double bonds.
D. odd numbers of carbon atoms and *trans* double bonds.
E. even numbers of carbon atoms and *cis* double bonds.

15. Carnauba wax has the structure, $CH_3(CH_2)_{30}CO_2(CH_2)_{33}CH_3$. Which alcohol would be released by the hydrolysis of the wax?

A. $CH_3(CH_2)_{31}OH$
B. $CH_3(CH_2)_{30}OH$
C. $CH_3(CH_2)_{32}OH$
D. $CH_3(CH_2)_{33}OH$
E. $CH_3(CH_2)_{34}OH$

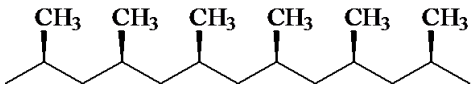
16. Which is the correct ranking of the following bases from **highest pKa to the lowes**t? (Remember: pKa can be used as a relative value. It is found in most literature references for bases which relates the molecule's basicity from its conjugate's acidity.)



I II III IV V

A. IV > II > III > I > V
B. V > I > III > II > IV
C. III > V > II > I > IV
D. IV > I > III > II > V
E. V > II > III > I > IV

17. Which one of the following best describes the polymer chain shown below?



A. atactic polypropylene
B. isotactic polypropylene
C. syndiotactic polypropylene
D. cross-linked polypropylene
E. high density polyethylene

18. *Saccharomyces cerevisiae,* Baker's yeast, which if used in your last experiment would have improved the quality of your flour/dough, has over 12 million genetic bases and 6,275 genes on 16 chromosomes. Its DNA shares about 23% of human DNA, and has 18% cytosine. What is the percentage of adenine in the DNA of *Saccharomyces cerevisiae*?

A. 9% B. 18% C. 32% D. 36%

19. Which of the following DNA base sequences is the complementary strand to the DNA sequence shown below? (Consider: DNA strands run ***antiparallel.***)

(5') GGATTCGA (3')

A. (5') CCTAAGCT (3')
B. (5') TGCAATGG (3')
C. (5') TCGAATCC (3')
D. (5') CCTAAGCT (3')
E. (5') UCGAAUCC (3')

20. What is the total number of different tripeptides that can result from the combination of two L-alanines and one L-serine amino acids?

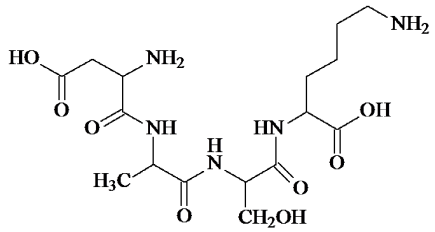
A. two B. three C. four D. six

End of Multiple Choice

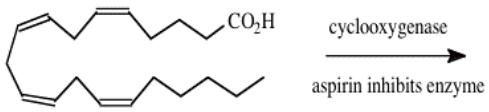
True (A) /False (B)*:* (Where there is more than one sentence, the first sentence in all of the statements is correct. Consider the others in deciding whether the question is True or False in those cases.)

21. The following compounds are correctly listed in order of decreasing rate of hydrolysis:
    acetyl chloride > acetic anhydride > methyl acetate > acetamide > acetic acid

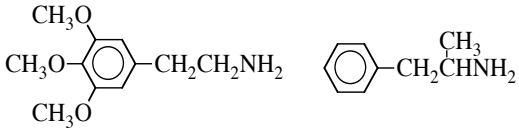
22. The abbreviated formula of the tetrapeptide shown below is asp-ala-ser-lys. (Hint: remember to start at the N-terminal end.)



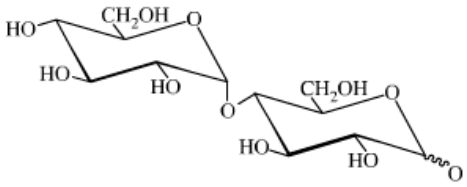
23. The cyclization of arachidonic acid, the reactant below, is associated with inflammation and pain in humans. NSAIDs (Non-steroidal anti-inflammatory drugs) such as aspirin block pain by inhibiting cyclooxygenase enzymes, COX 1, 2 or 3 in the reaction below. In the process, a steroid would be formed if aspirin were not present.



24. Mescaline and the amphetamine whose structures are shown below have structural similarities to the neurotransmitters serotonin and adrenalin. The structural feature that most likely accounts for their neurological activity is the substituted ethyl amine portion.



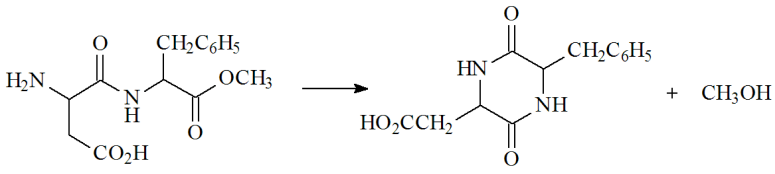
25. The following disaccharide has an α-1,4' linkage with both saccharides being D-.



26. Cholesterol is related to atherosclerosis, a form of heart disease. It is also a needed biosynthetic precursor for other steroids and incorporated into the cell's lipid bi-layer.

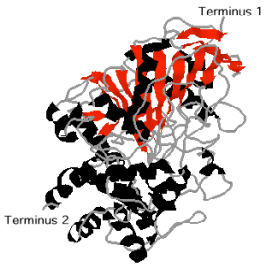
27. About 75% of the natural oil found in lemongrass is 3,7-dimethyl-(E,E)-2,6-octadienal. This aldehyde is classified as a sesquiterpene.

28. In aqueous solution, the artificial sweetener aspartame slowly converts to the cyclic compound shown below. This reaction is best described as nucleophilic acyl substitution



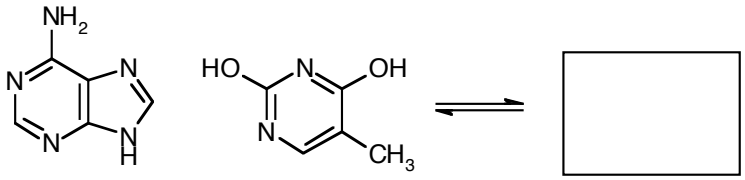
29. The physical properties of fats have been associated with their effects on arteries. Fats that are highly unsaturated are liquids at room temperature.

30. The following is a rendering of the enzyme acetylcholinesterase in cartoon format. The cartoon provides a visualization of the enzyme's 1° and 2° structures.



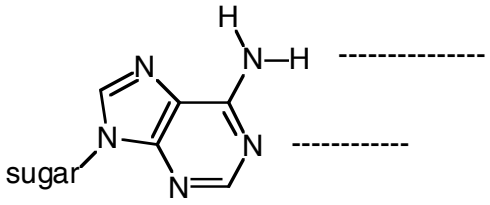
End of True/False

31. [6pts] The structures of Adenine (A) and Thymine (T) are shown below. a) Identify which is a purine and which is a pyrimidine beneath the respective structure. b) Redraw Thymine in its (di)-tautomeric form.



A T

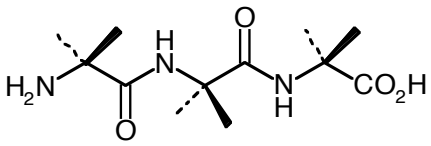
Watson and Crick needed help with their DNA discovery. Advice included how A and T could form the requisite hydrogen bonds in DNA that correlated to the overall bond lengths found in Rosalind Franklin's Photo #51's X-ray diffraction pattern. Using the tautomeric form that you drew above, complete the drawing below showing the hydrogen bonded A-T pair using the dotted lines to represent the hydrogen bonds.



Name the sugar that would be found in the nucleosides. _____

32. [6pts] Several fermentation experiments leading to the peptide fat substitute *Simplesse* centered on polypeptides of 3 amino acids: alanine, serine and glutamic acid [glutamate], R = -CH_3; -CH_2OH; and -$CH_2CH_2CO_2H$ respectively.

One experiment produced a tripeptide which had the following sequence **Ser·Glu·Ala**
Complete the stereochemical structure for the all L-isomer of the tri-peptide:



What RNA **codon** sequence could be targeted to code for the amino acid sequence? (Don't forget to provide a complete set of coding instructions including start and stop.)

Ser·Glu·Ala

33. [6pts] Select ***one*** of the structures on the right that applies to each of the respective terms on the left. Some of the structures may apply to more than one term, but be advised that the number wrong will be subtracted from the number correct.

α-anomer _____

β-anomer _____

Furanose _____

Pyranose _____

Furanoside _____

Pyranoside _____

Nucleoside _____

Nucleotide_____

Glycoside _____

Monosaccharide _____

Disaccharide _____

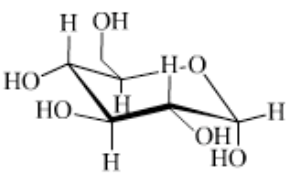
Trisaccharide _____

Triglyceride _____

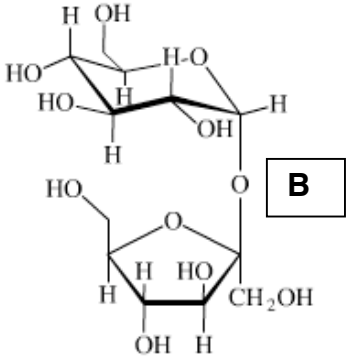
Prostaglandin _____

Asteroid _____

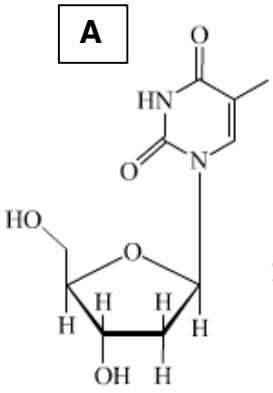
Steroid _____



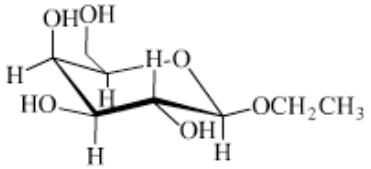
A



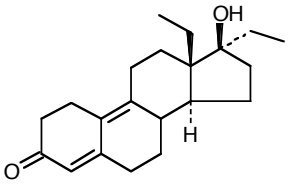
B



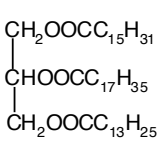
C



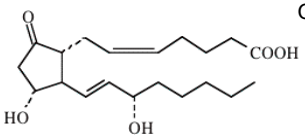
D



G

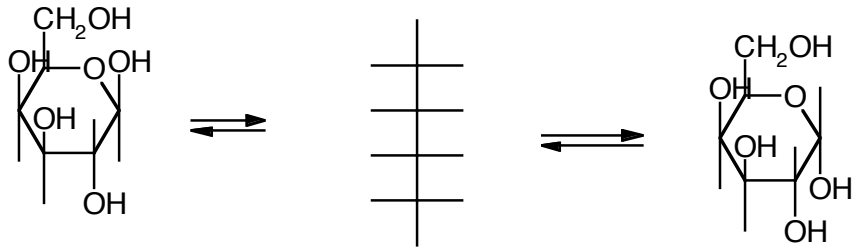


E



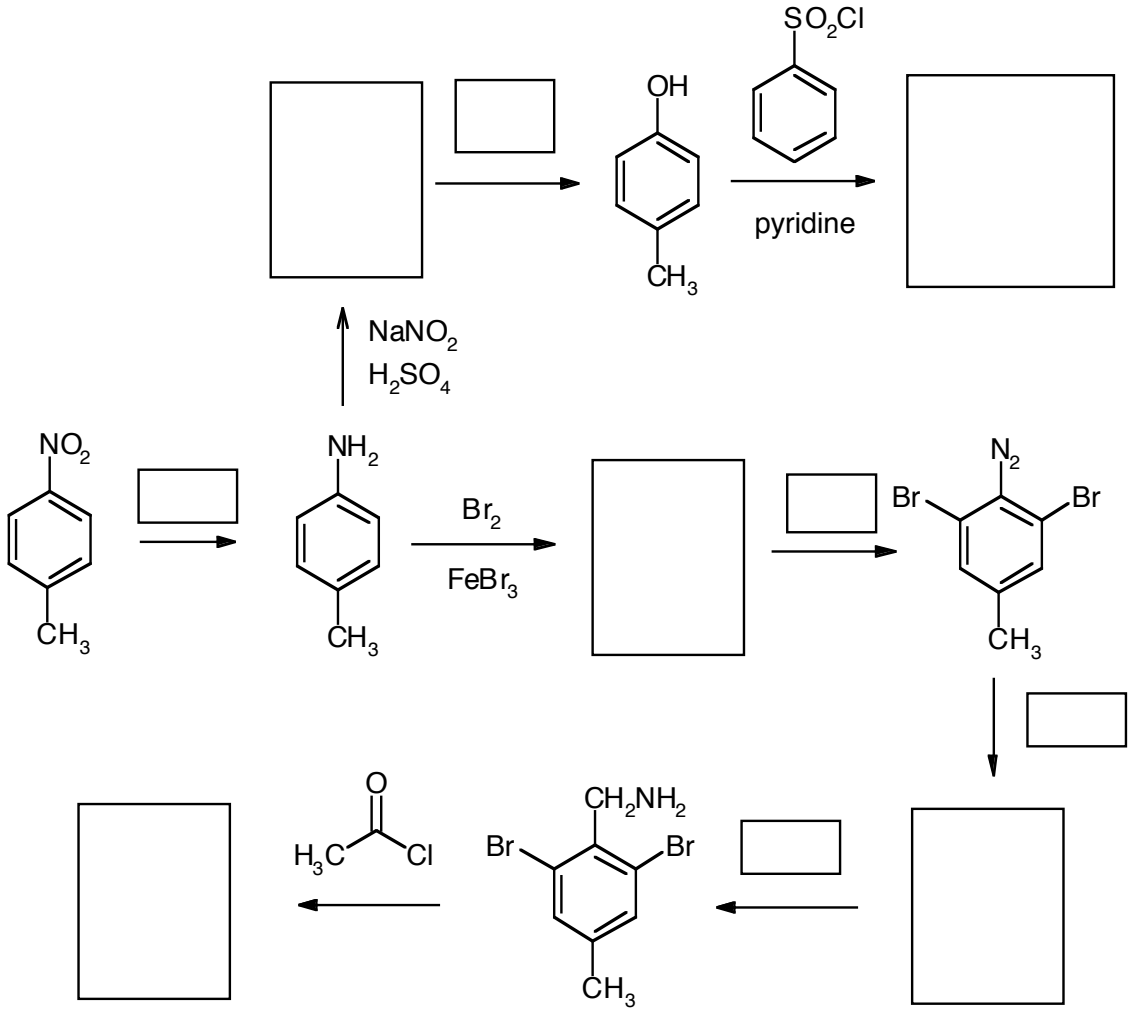
F

34. [4pts] Mutarotation is observed in the following equilibria, where the optical rotation of the cyclized forms are different. Complete the Fischer projection.



The sugar is: reducing / non-reducing. (Circle one.)

35. [10pts] Provide structures and reagents



Addendum (for your consideration):