Intersession 2013 Midterm Stats

Min = 37.5
Max = 100 (one student)
Mean = 75 (mean from Intersession 2013 was 73)
Median = 78
SD = 14

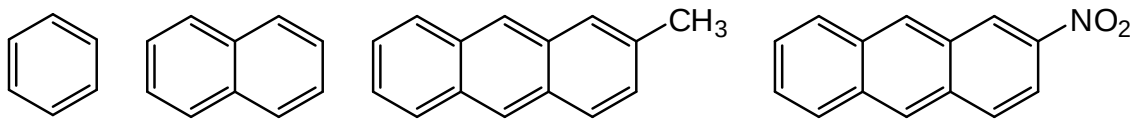
Approximate percentiles: If your mark is…

- 95 or higher, then you are in the top 5% of the class.
- 90 or higher, then you are in the top 20% of the class.
- 80 or higher, then you are in the top 48% of the class.
- 70 or higher, then you are in the top 70% of the class.

1. Suppose a cat appears white when it is illuminated by sunlight. When the same cat is placed in dark room and light from a green laser pointer is shone on the cat, what colour does the cat appear?

A) Red
B) Black
C) White
D) Green
E) Both red and white, because Schrödinger said that the cat could be both dead and alive at the same time

2. Rank the compounds below in the order of increasing wavelength of maximum absorption, from the shortest to the longest.



1 **2** **3** **4**

	Shortest	→		Longest
A)	**1**	**2**	**3**	**4**
B)	**4**	**3**	**2**	**1**
C)	**1**	**2**	**4**	**3**
D)	**3**	**4**	**2**	**1**
E)	**4**	**1**	**2**	**3**

3. Which statement regarding singlet and triplet states is correct?

A) Triplet states contain three excited electrons, while singlet states contain one
B) Triplet states can fluoresce, while singlet states can phosphoresce
C) Triplet states do not have vibrational levels, while singlet states do
D) Triplet states are formed by vibrational cooling from the (S_1, υ_0) state
E) None of the above

4. How many of the following statements about the four π-type molecular orbitals of ground-state 1,3-butadiene are correct?

- The four molecular orbitals have identical energy.
- Each molecular orbital is occupied by only one electron.
- Four 2*p* atomic orbitals are used to make the four molecular orbitals.
- Each molecular orbital has a different number of nodes.

A) 4
B) 2
C) 1
D) None are correct
E) 3

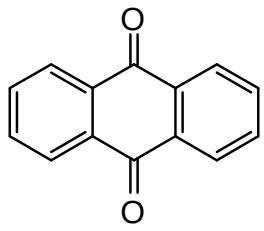
5. What type of chromophore is found in chlorophyll?

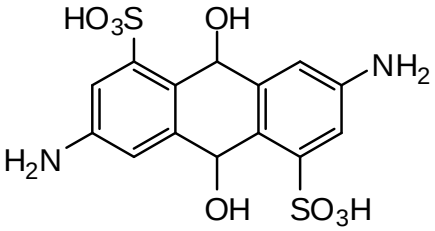
A) Triarylmethane
B) Phenolphthalein
C) Benzoquinone
D) Porphyrin
E) Diaryl azo

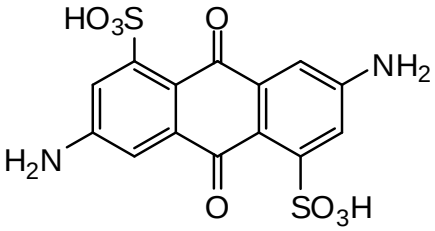
6. Chlorophyll is most likely to be found in which part of the plant cell?

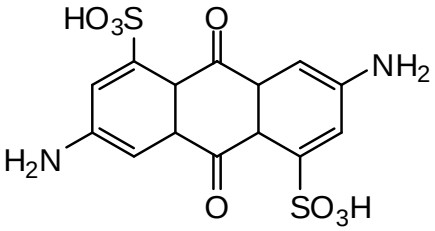
A) Cytoplasm
B) Thylakoids
C) Ribosomes
D) Mitochondria
E) None of the above

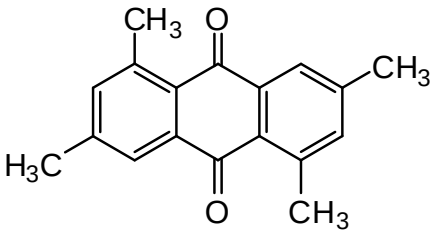
7. Which one of the following absorbs the longest wavelength of light?

A) 

B) 

C) 

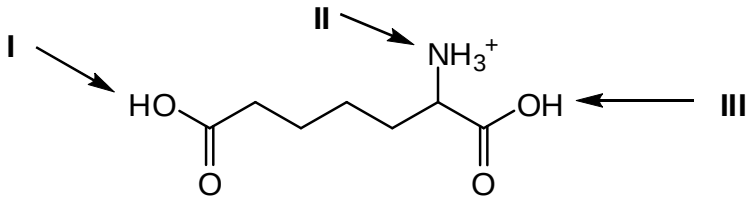
D) 

E) 

8. In prokaryotes, the chemical reactions used for energy production occur in which part of the cell?

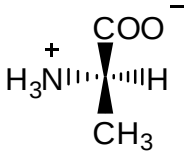
A) Cytoplasm
B) Nucleus
C) Mitochondria
D) Flagellum
E) Ribosome

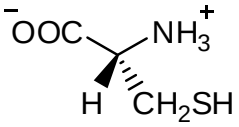
9. 2-Aminopimelic acid is an amino acid produced by certain plants. Which one of A – E is most likely to be the correct set of pK_a values for the indicated functional groups?

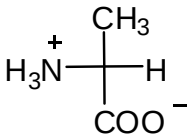


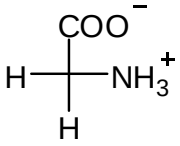
	I	II	III
A)	2	10	5
B)	5	10	2
C)	2	5	10
D)	10	2	5
E)	5	2	10

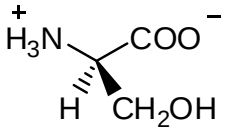
10. Which one of the following amino acids is most likely to be naturally occurring?

A) 

B) 

C) 

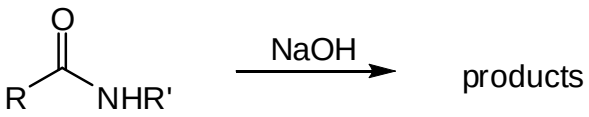
D) 

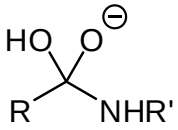
E) 

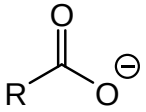
11. The tertiary structure of a protein best refers to…

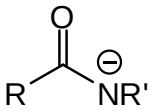
A) The arrangement of the peptide into a β-sheet
B) The presence of heme molecules bound to protein
C) The interaction of protein subunits
D) The way the protein folds over on itself
E) The arrangement of the peptide into a α-helix

12. Which one of A – E is *least likely* to be involved in the mechanism of, or be formed in, the following reaction?



A) 

B) 

C) 

D) 

E) H_2NR'

13. A mixture containing alanine, arginine, histidine, and valine was dissolved in a buffer at pH 6 and injected into an HPLC equipped with the column discussed in class (negatively charged and hydrophobic). What is the order of elution of the amino acids from the column, from first to last?

	First	⟶		Last
A)	His	Ala	Val	Arg
B)	Ala	Val	His	Arg
C)	Ala	Val	Arg	His
D)	Arg	His	Ala	Val
E)	His	Arg	Val	Ala

14. Which statement regarding amino acid analysis is correct?

A) The amino acids are converted into coloured derivatives, which are then separated by the HPLC column.

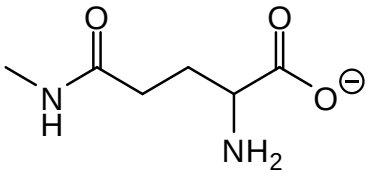
B) The identity of the amino acids can be determined because each amino acid, with the exception of proline, produces a different colour.

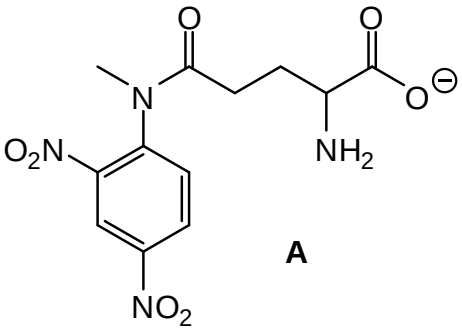
C) The quantity of each amino acid can be determined by comparing the relative peak areas produced by the HPLC.

D) Both B and C are correct

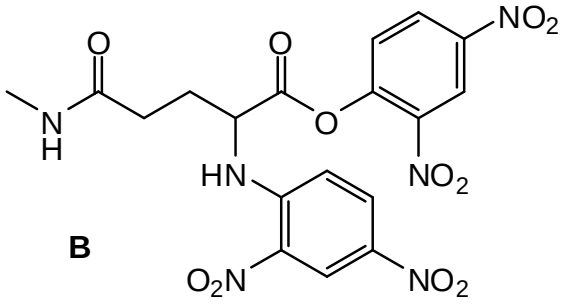
E) All of A, B, and C are correct

15. When the compound on the right reacts with excess Sanger's reagent (1-fluoro-2,4-dinitrobenzene), what is the product formed?

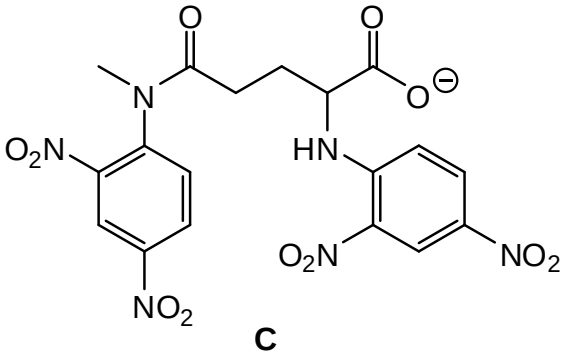




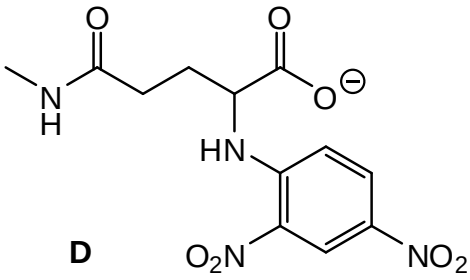
A



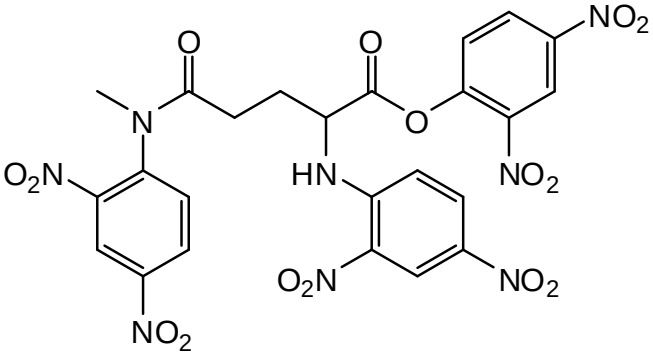
B



C

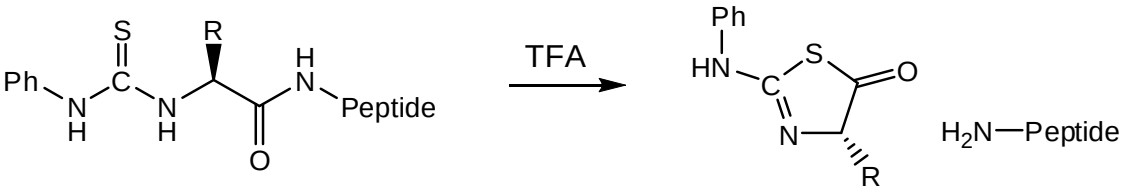


D

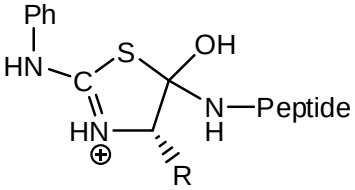


E

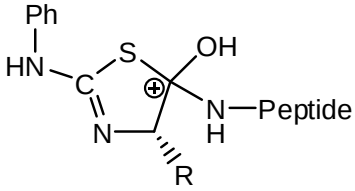
16. Which one of A – E is *least likely* to be involved in the following reaction?



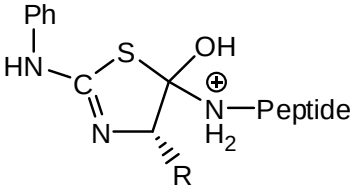
A)



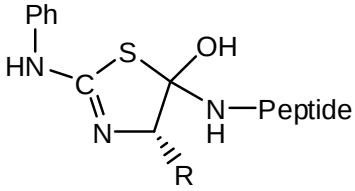
B)



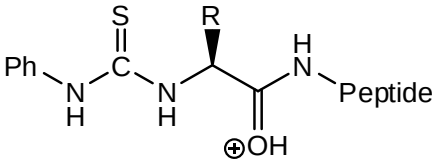
C)



D)

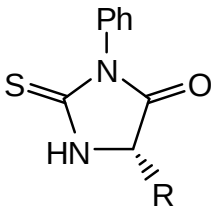


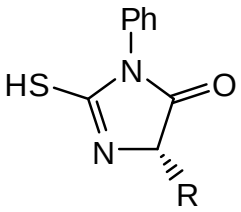
E)



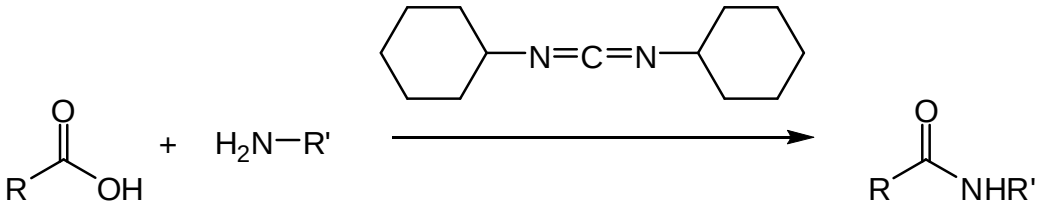
17. The two structures shown below are best described as…

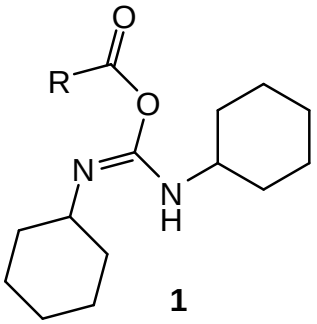
A) Diastereomers
B) Tautomers
C) Resonance structures
D) Anomers
E) Epimers



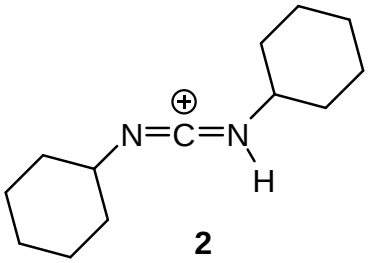


18. Which of A – E is/are *least likely* to be involved in the following reaction?

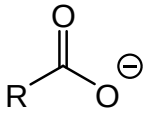




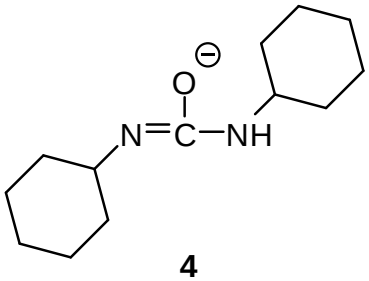
1



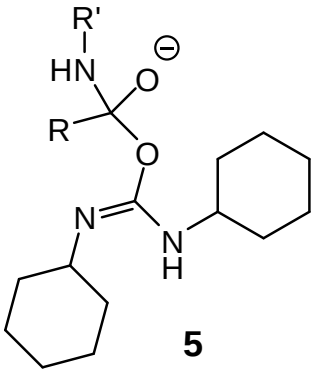
2



3



4



5

A) **1** and **5** only

B) **3** only

C) None (all of **1** – **5** are involved)

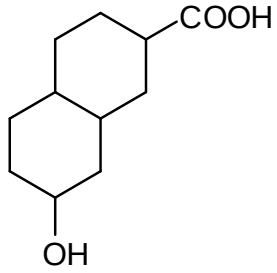
D) **4** only

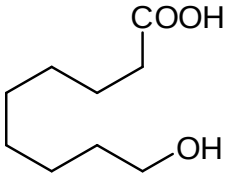
E) **2** only

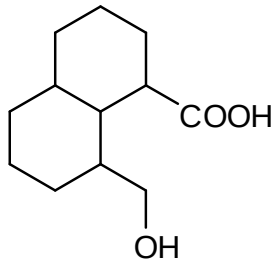
19. What is the purpose of the BOC protecting group?

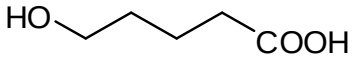
A) To increase the nucleophilicity of the COOH group
B) To convert the OH group into a better leaving group
C) To convert the COOH group into a more-reactive acid derivative
D) To decrease the nucleophilicity of the amino group
E) To convert the amino group into a better leaving group

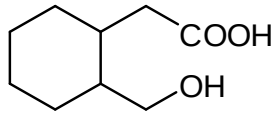
20. Which one of the following compounds is expected to undergo the most rapid acid-catalyzed lactonization?

A) 

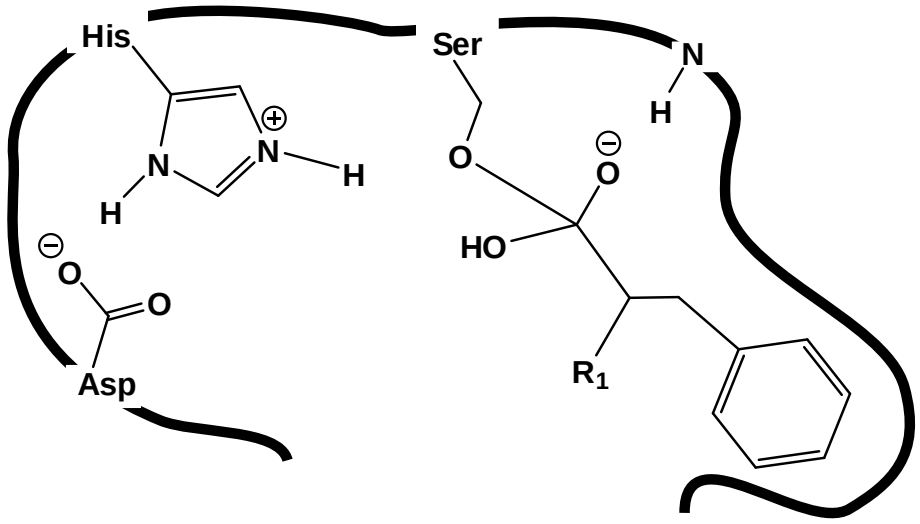
B) 

C) 

D) 

E) 

21. Which statement does not correctly describe the current state of the chymotrypsin-substrate complex below and the next mechanistic step that occurs?



A) The function of Asp is to hold the imidazole ring of His in the proper orientation.

B) This state was formed by the addition of water to an acyl enzyme.

C) In the next step, the C-terminal fragment of the original substrate departs.

D) In the next step, histidine protonates the serine oxygen.

E) The aromatic ring interacts with the enzyme via hydrophobic interactions.

22. Which one of the following statements regarding the biosynthesis of proteins is not correct?

A) Each amino acid is coded for by three nucleobases.

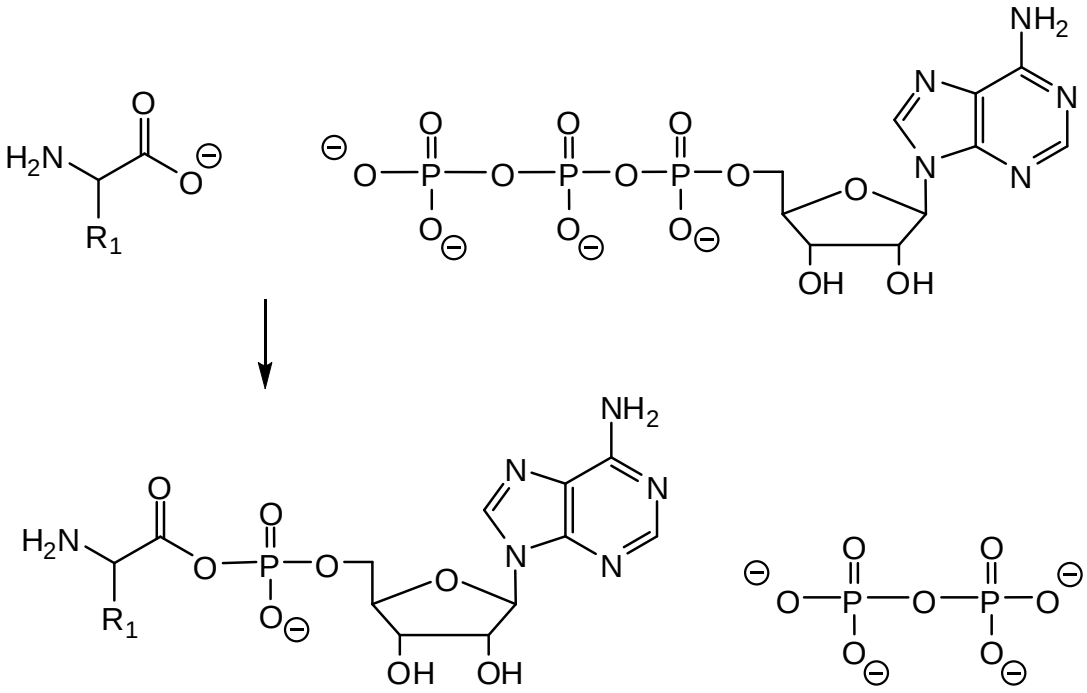
B) More than one codon can code for the same amino acid.

C) The ribosome is composed of two subunits.

D) Amino acids are linked to tRNA as an ester.

E) The peptidyl transferase reaction is catalyzed by histidine.

23. Which statement(s) is/are correct about this enzyme-catalyzed reaction?

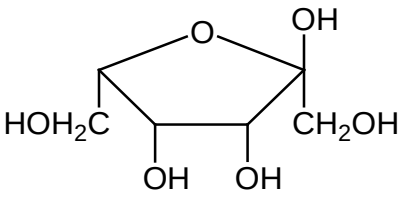


1. Mg^{2+} coordinates to the phosphate oxygens to make P more nucleophilic
2. An O^- bonded to ~~phosphorous~~ is the nucleophile
3. A tetrahedral intermediate is formed during the reaciton

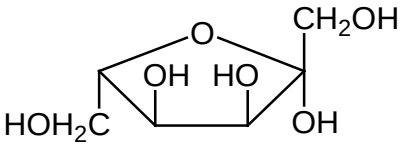
A) None of the statements are correct
B) 3 only
C) 1 only
D) 2 and 3 only
E) All the statements are correct

24. Which one of the following is β-L-tagulose?

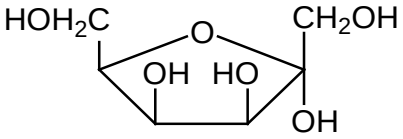
A)



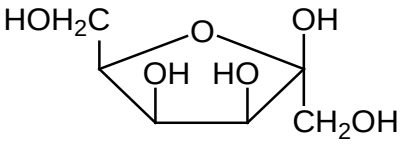
B)



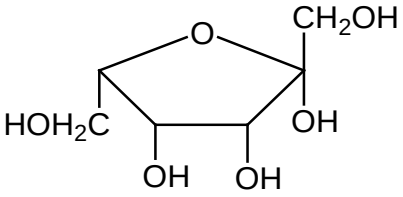
C)



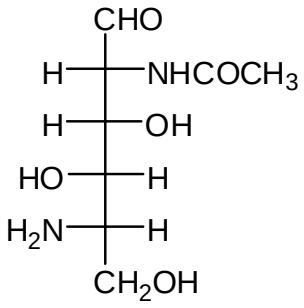
D)



E)

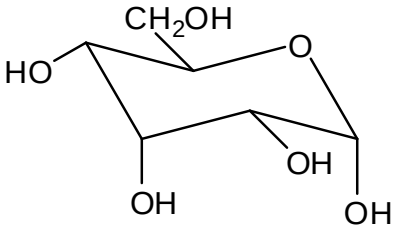


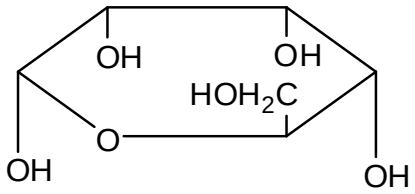
25. What is a correct name for the compound shown below?



A) 2,5-dideoxy-2-*N*-acetylamino-5-amino-L-idose
B) 2-*N*-acetylamino-5-amino-L-mannose
C) 2,5-dideoxy-2-*N*-acetylamino-5-amino-L-gulose
D) 2,5-dideoxy-2-*N*-acetylamino-5-amino-L-mannose
E) 2-*N*-acetylamino-5-amino-L-gulose

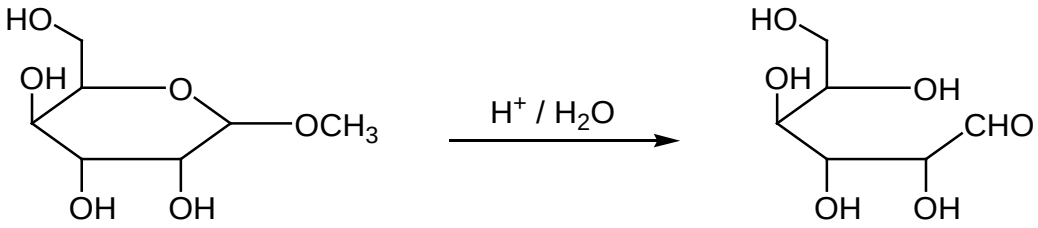
26. What is the relationship between the two structures shown below?



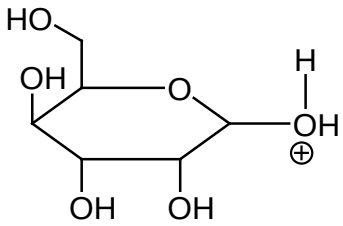


A) Anomers
B) Diastereomers
C) Identical
D) Enantiomers
E) Constitutional (structural) isomers

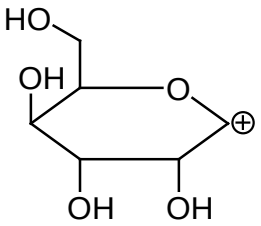
27. Which one of the following is least likely to be involved in the mechanism of the hydrolysis reaction shown below?



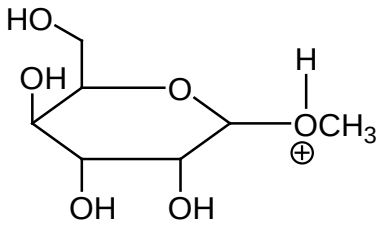
A)



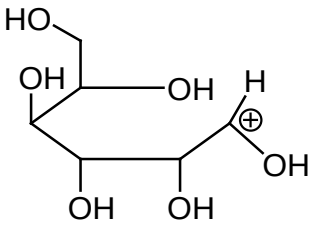
B)



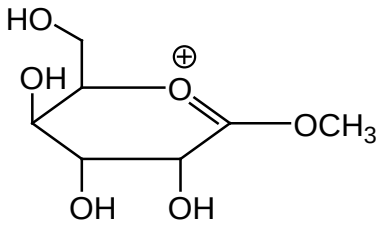
C)



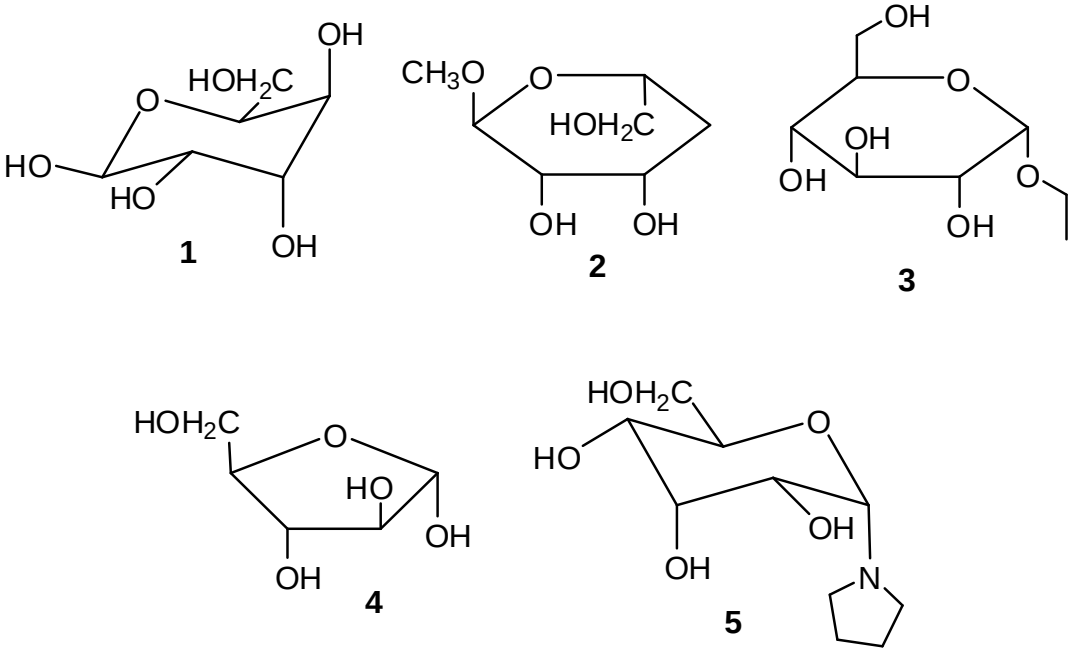
D)



E)



28. Which of the following can undergo mutarotation?



A) **3** and **4** only

B) **3**, **4**, and **5** only

C) **2**, **3**, and **5** only

D) **2** and **3** only

E) **1** and **4** only

29. Both D-gulose and an unknown compound form the same product when treated with nitric acid. What is the unknown compound?

A) L-Glucose

B) D-Glucose

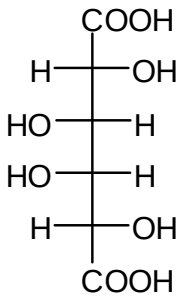
C) D-Talose

D) L-Mannose

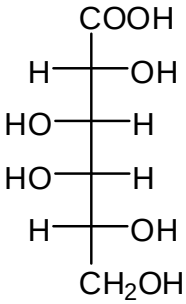
E) D-Mannose

30. Which one of the following is D-galactaric acid?

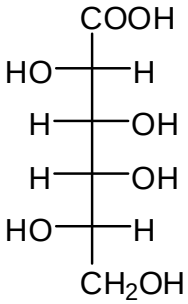
A)



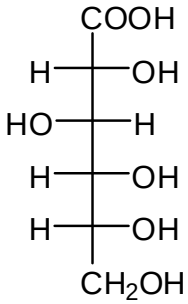
B)



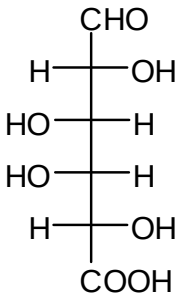
C)



D)



E)



31. Reduction of D-ribulose with $NaBH_4$ forms equal amounts of two products, **Y** and **Z**, *i.e.* 50% yield of each. Product **Y** does not rotate plane-polarized light. Similar reduction of which one of the following sugars would give product **Z** in 100% yield?

A) D-xylose

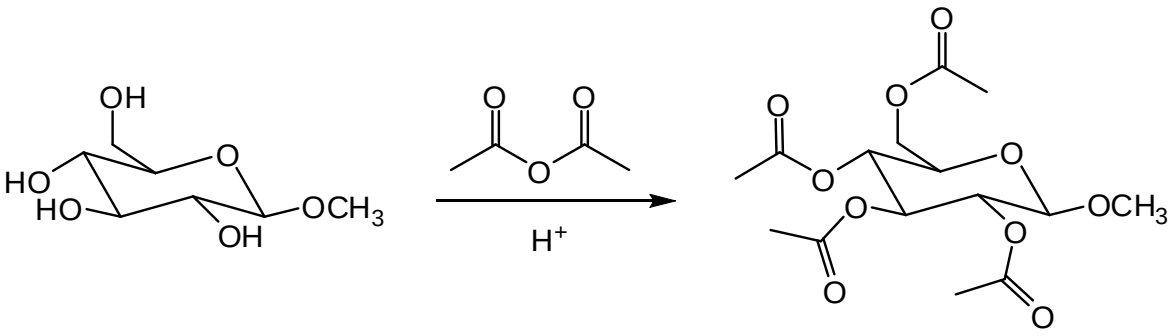
B) D-xyulose

C) D-glucose

D) D-lyxose

E) D-ribose

32. What is the purpose of acid in the reaction below?



A) It turns the OH group of the carbohydrate into a better leaving group.

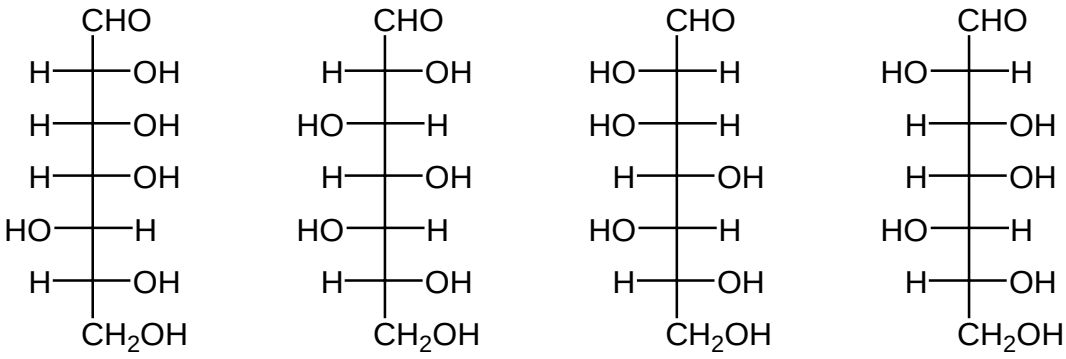
B) It makes the carbonyl group of the anhydride more reactive.

C) It ensures that only one stereoisomer is made.

D) Both A and B are correct

E) Both B and C are correct

33. Starting with an aldopentose, a student performed two cycles of the Killiani-Fischer synthesis. The products were then separated to obtain the four compounds shown below. What was the aldopentose used?



A) D-xylose

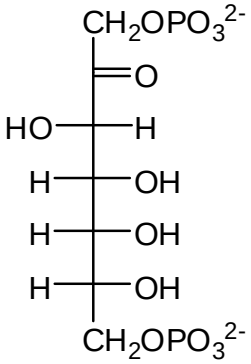
B) D-arabinose

C) D-lyxose

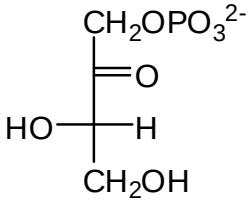
D) D-ribose

E) There is insufficient information to determine the aldopentose

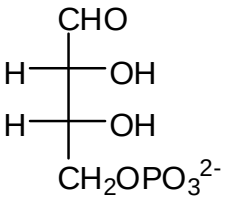
34. Sedoheptulose-1,7-bisphosphate is a key component in the dark reactions of photosynthesis. It can be synthesized via an enzyme-catalyzed aldol reaction between which two compounds shown in **I** – **VI** ?



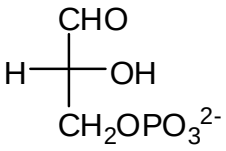
Sedoheptulose-1,7-bisphosphate



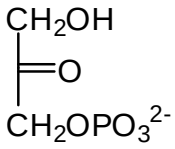
I



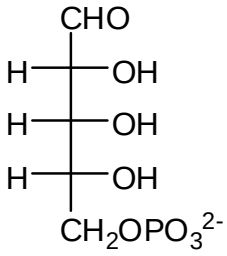
II



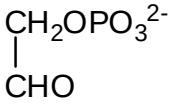
III



IV



V



VI

A) **I** and **IV**

B) **II** and **IV**

C) **II** and **III**

D) **I** and **III**

E) **V** and **VI**

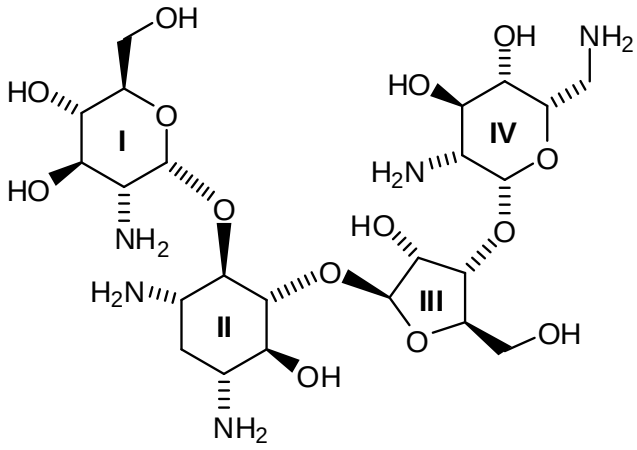
35. When a solution of sucrose is treated with an enzyme from the stomach of the bee, the optical rotation is observed to change from +66 to −40 degrees. Which type of reaction best describes what happened to the sucrose?

A) Racemization
B) Oxidation
C) Mutarotation
D) Hydrolysis
E) Isomerization

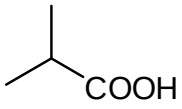
36. *Neomycin*, shown below, is a tetrasaccharide belonging to the aminoglycoside antibiotic family. Which statements is/are correct about neomycin?

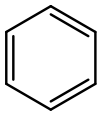
1. It is a reducing sugar
2. Rings **III** and **IV** are linked by a β glycosidic linkage
3. Ring **I** is derived from D-galactose

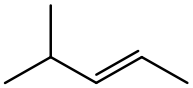
A) 2 and 3 only
B) 1 and 3 only
C) 2 only
D) 1 only
E) 1 and 2 only

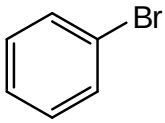


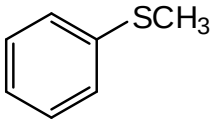
37. Which one of the following compounds will have the lowest R_f value when run on a TLC plate made of silica gel?

A) 

B) 

C) 

D) 

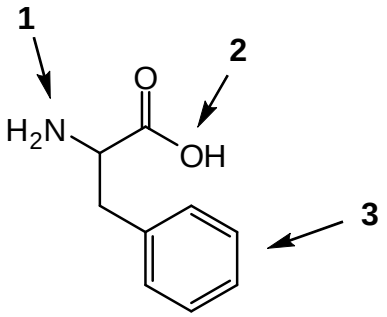
E) 

38. Caffeine has no visible colour, but when it is spotted on a TLC plate, a spot is observed when the plate is placed under a UV lamp. Which one of A – E correctly explains this phenomenon?

A) Caffeine absorbs UV light, preventing it from reaching the dye on the plate
B) Caffeine transmits UV light, which illuminates the spot on the plate
C) Caffeine reacts with the TLC plate in the presence of UV light
D) Caffeine absorbs UV light and fluoresces
E) Caffeine reflects UV light

39. When D,L-phenylalanine, shown below, is treated with acetic anhydride, which group(s) is/are acetylated?

A) 1 only
B) 2 only
C) 3 only
D) 1 and 2 only
E) 2 and 3 only



40. The acetylation of D,L-phenylalanine is best described by what type of reaction mechanism?

A) S_N1 reaction
B) S_N2 reaction
C) Electrophilic aromatic substitution
D) Nucleophilic aromatic substitution
E) Nucleophilic acyl substitution

End of test. Marks and answers will be posted after the test has been marked and statistical analyses have been performed.