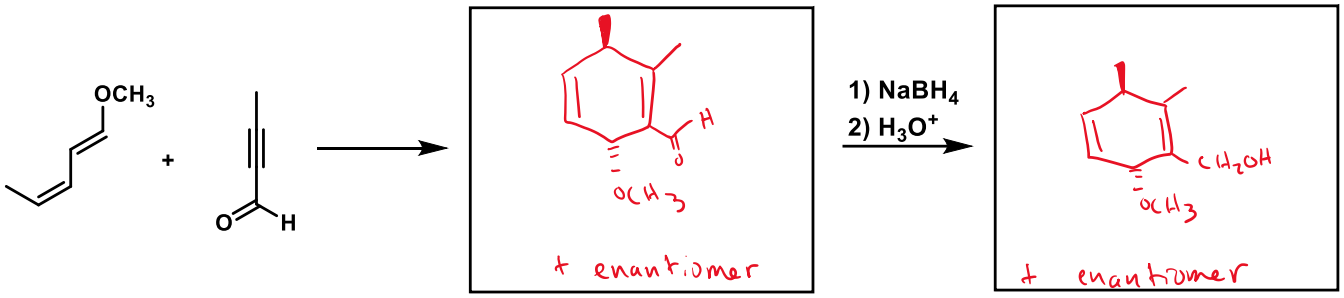
CHEM 212 **Spring 2023** **Exam 3 – Part 1**

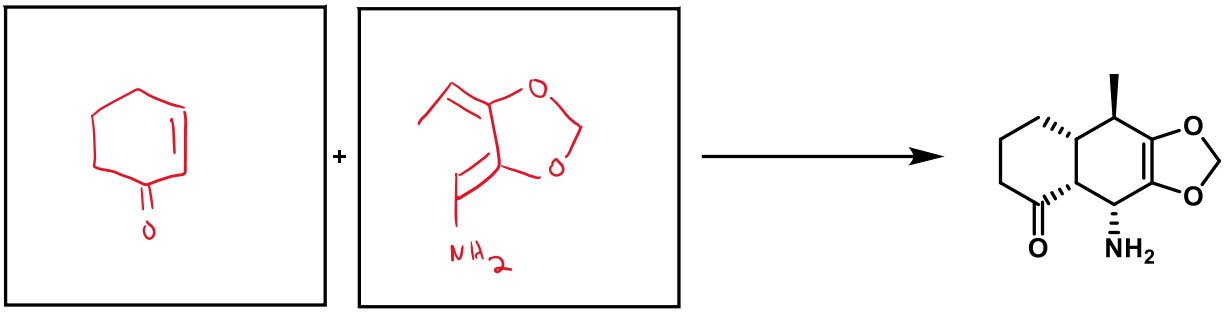
Name: _____

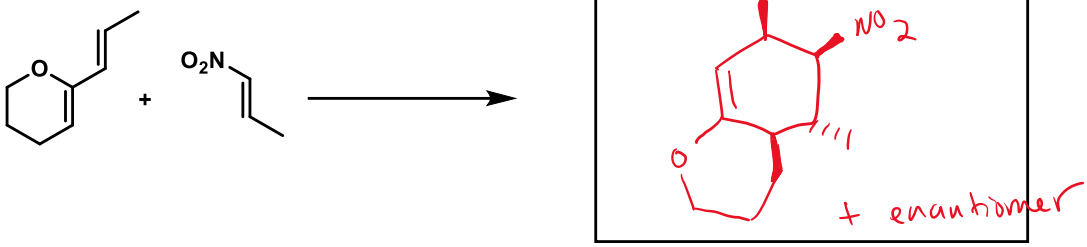
IA												IIIA	IVA	VA	VIA	VIIA	0
1 H 1.008	IIA																2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	IIIB	IVB	VB	VIB	VIIB		VIIIB		IB	IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 * La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226.0)	89 ** Ac (227)	104 Rf	105 Ha	106 Unh	107 Uns	108	109 Une									

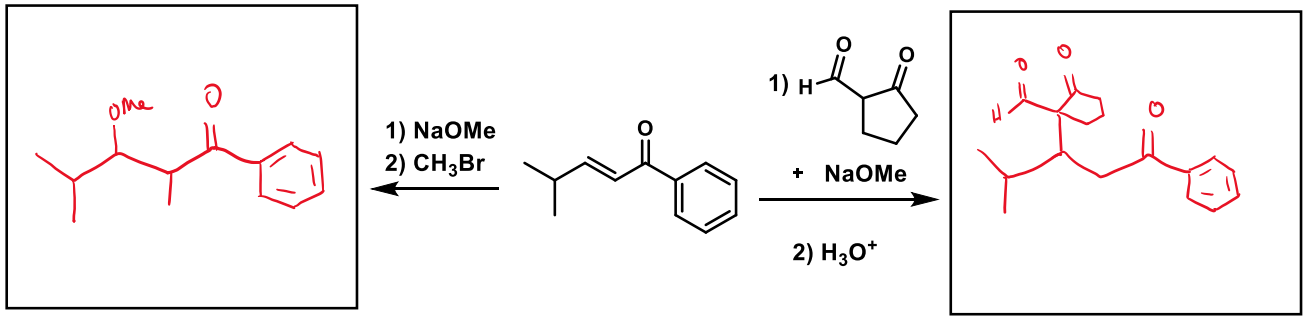
* 58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
** 90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (244)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

1. Fill in each missing product or reactant in the boxes below. Be sure to indicate stereochemistry for Diels-Alder reactions (stereochemistry not needed for any other reactions). (20 pts)

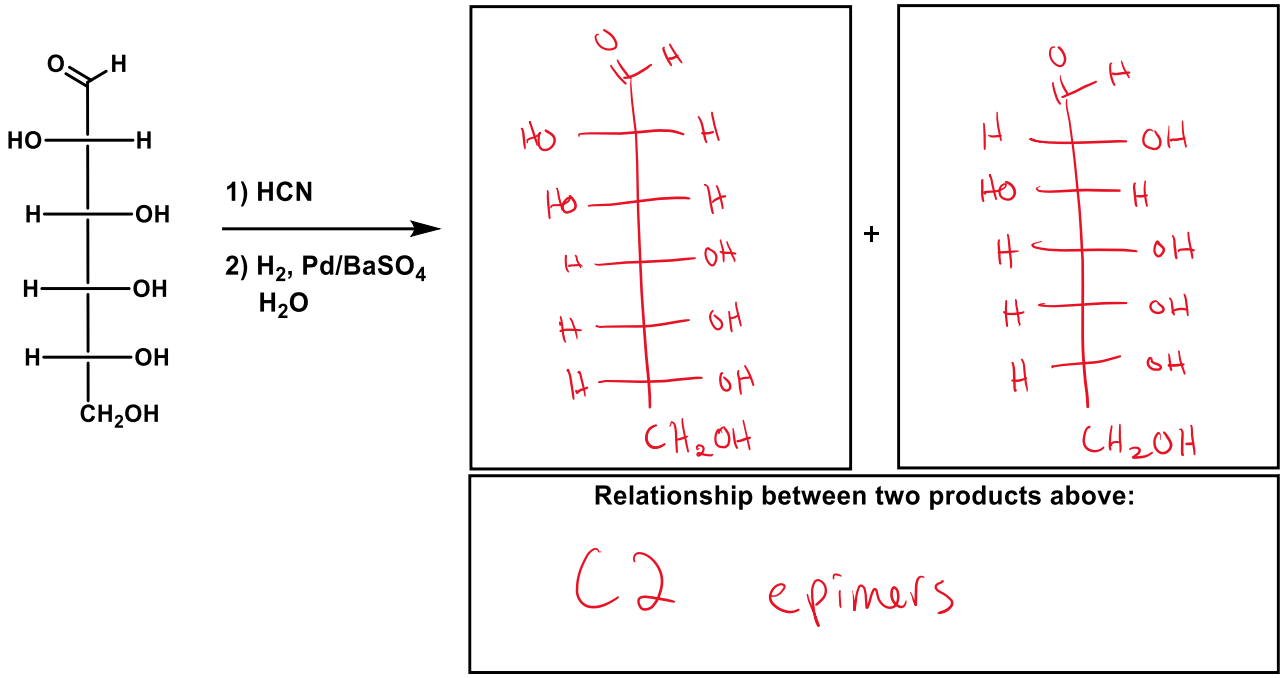




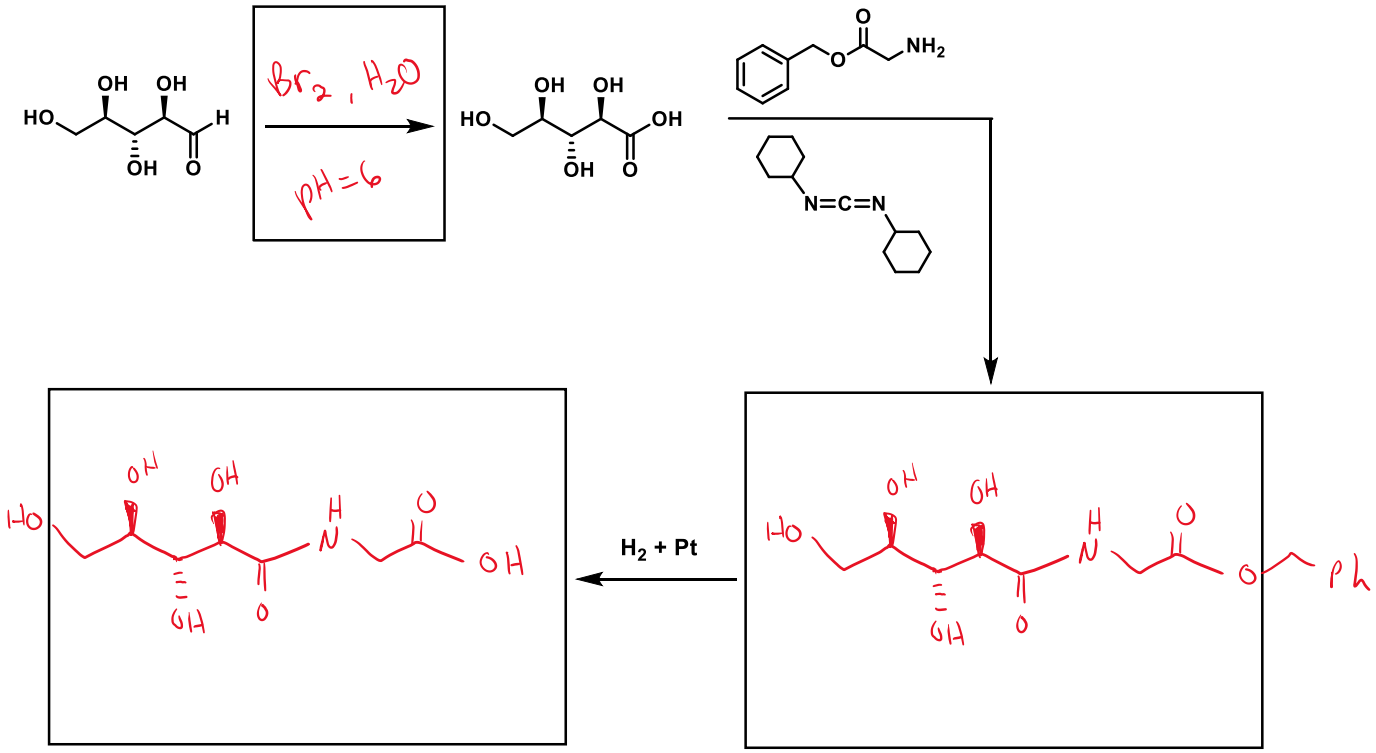




2. Draw the products of the following reaction and describe the relationship between the two products. **Be as specific as possible** in your description of their relationship! (6 pts)

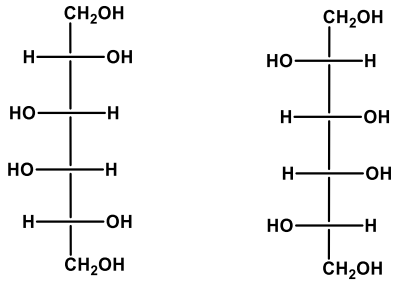


3. Fill in each missing reagent or product in the synthetic scheme shown below. (7 pts)



4. Select the **best** answer for each question below. Put your answers in the boxes provided. (12 pts total)

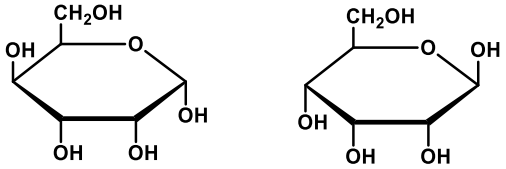
The relationship between the two structures below is best described as:



A (answer)

A) Identical B) Enantiomers C) Anomers D) Diastereomers

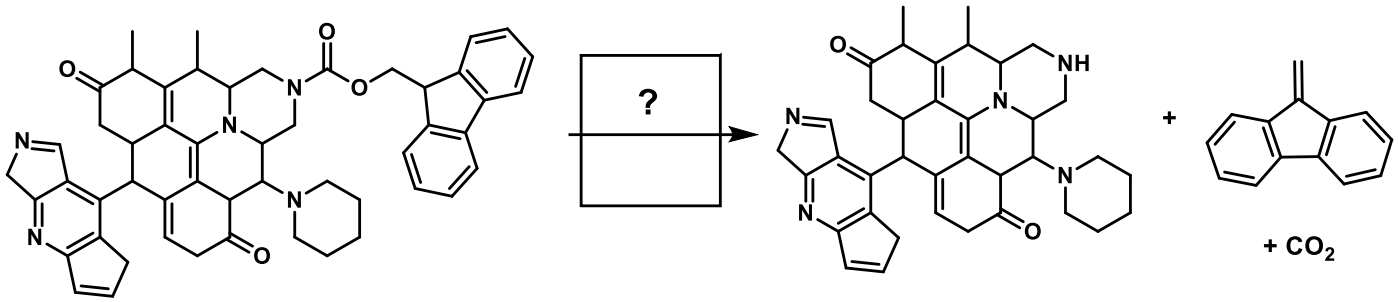
The relationship between the two structures below is best described as:



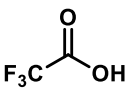
D (answer)

A) Identical B) Enantiomers C) Anomers D) Diastereomers

Which reagent below will achieve the following transformation?



D (answer)



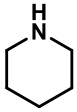
A)

HBr

B)

DCC

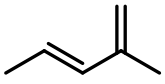
C)



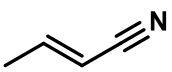
D)

Which of the following could act as Michael acceptor?

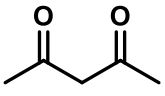
B (answer)



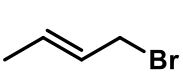
A)



B)



C)



D)

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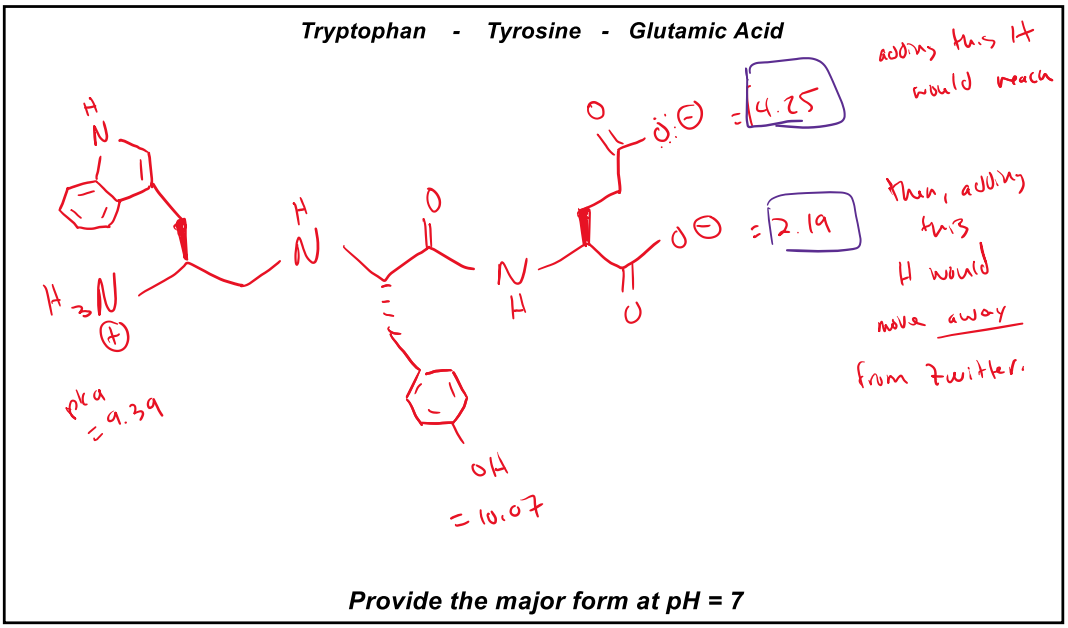
Amino acid tables are attached as the last two pages of this document. You may tear them off for easier reference.

5. In the box on the left, provide the major form of the following tripeptide of L-amino acids at pH = 7. In the box to the right, show how you would calculate the pI of this peptide. (12 pts)

Tryptophan - Tyrosine - Glutamic Acid



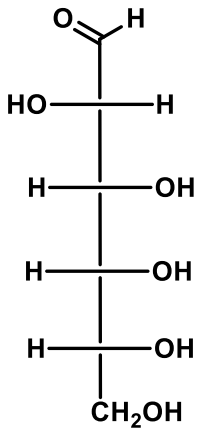
Provide the major form at pH = 7

Isoelectric Point

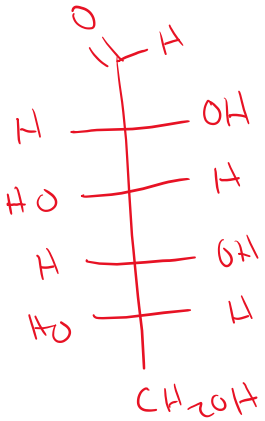
$$\frac{2.19 + 4.25}{2}$$

(just show calculation - no final answer needed)

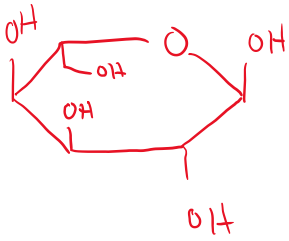
6. The Fischer projection of D-Altrose is shown below. Idose is a C4 epimer of Altrose. Use this information to draw the missing structure in each box below. (8 pts)



D - Altrose

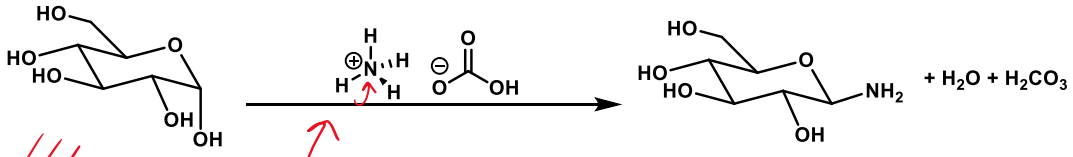


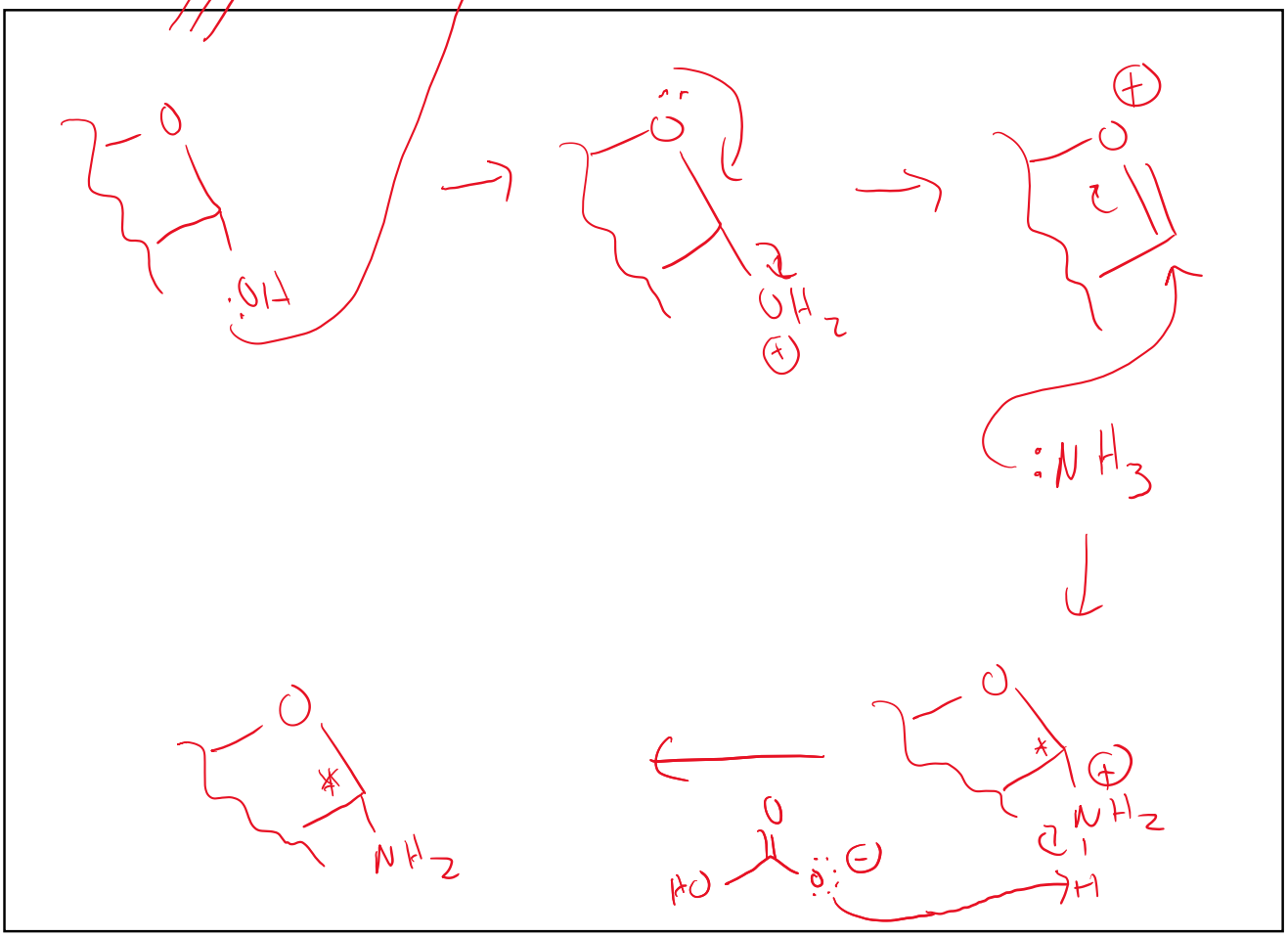
L - Idose
Fischer Projection



α - L - Altropyranose
Haworth Projection

7. In class we learned how to convert glucopyranose into glycosides; glycosylamines can be made in a similar fashion, as shown below. In the first box, provide a mechanism for glycosylamine formation. Then, provide a ***BRIEF*** explanation for why only the anomeric OH is substituted and not the other OH groups. (You could refer to your mechanism as part of this explanation.) (12 pt)



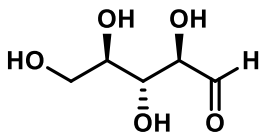


Explanation

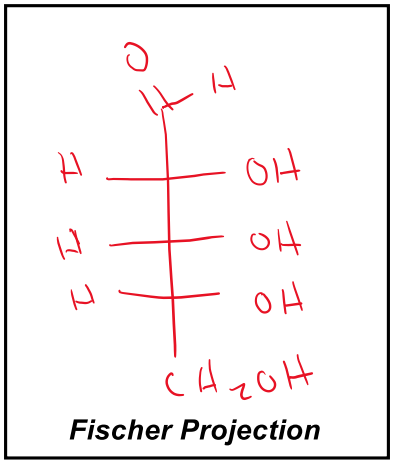
only one that forms resonance stabilized $C^{\oplus}$ (via $=O^{\oplus}-$)

upon $-OH_2^{\oplus}$ leaving.

8. The bond-line structure of D-Ribose is shown below. Draw the Fischer projection of D-Ribose. Then circle the term that correctly classifies D-Ribose. (6 pts)



D-Ribose



Fischer Projection

D-Ribose is a(n)....

Aldohexose

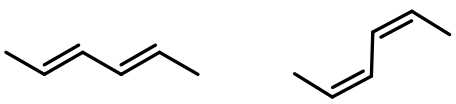
Aldopentose

Ketohexose

Ketopentose

(circle one)

9. Rank the following dienes below in terms of the rate of their Diels-Alder reaction with $CH_2=CH_2$. (5 pts) (**1** = fastest Diels-Alder reaction; **3** = slowest)



always s-cis → fastest

Rank: [2] [3] [1]

must strained s-cis → slowest

Bonus (1 pt all or nothing): We discussed each of these terms at some point during this semester. Mark each definition below as true or false. You must get all 3 correct to get the bonus point!

pKa = -log(Ka) T

pH = -log[H^+] T

pI = -log[I^-] F

I accepted F too in case you thought $-\log[H_3O^+]$ was a trick!

10. Provide a complete synthesis of the following tripeptide starting from the individual L-amino acids: Phenylalanine – Leucine – Threonine. You may use abbreviations for reagents and protecting groups, where appropriate, but you must draw the full structure of the tripeptide at the end, and you must show the full structure of each amino acid at least once. (12 pts)

Phenylalanine - Leucine - Threonine

See practice Exam 3 key. Same process, diff. amino acids.

TABLE 25.1 THE STRUCTURES OF THE TWENTY NATURALLY OCCURRING AMINO ACIDS THAT ARE FOUND IN PROTEINS

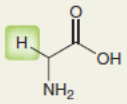
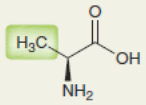
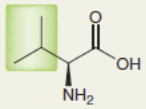
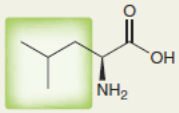
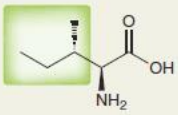
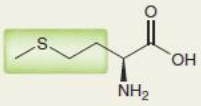
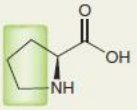
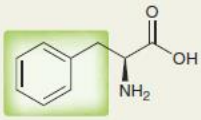
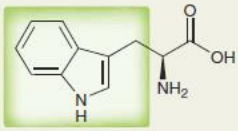
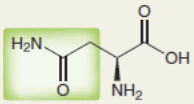
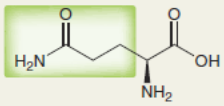
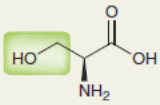
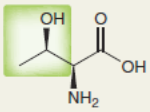
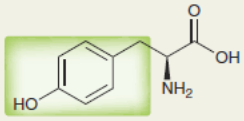
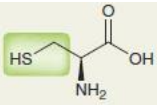
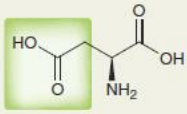
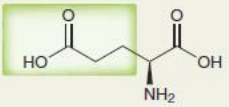
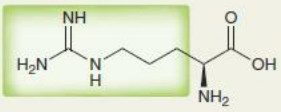
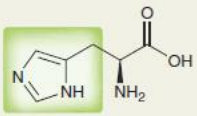
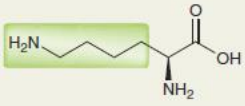
Name	Structure	Abbreviation
Amino acids with nonpolar side chains		
Glycine		Gly G
Alanine		Ala A
Valine		Val V
Leucine		Leu L
Isoleucine		Ile I
Methionine		Met M
Proline		Pro P
Phenylalanine		Phe F
Tryptophan		Trp W
Amino acids with polar side chains		
Asparagine		Asn N
Glutamine		Gln Q
Serine		Ser S
Threonine		Thr T
Tyrosine		Tyr Y
Cysteine		Cys C
Amino acids with acidic side chains		
Aspartic acid		Asp D
Glutamic acid		Glu E
Amino acids with basic side chains		
Arginine		Arg R
Histidine		His H
Lysine		Lys K

TABLE 25.2 THE pK_a VALUES FOR TWENTY NATURALLY OCCURRING AMINO ACIDS

AMINO ACID	α-COOH	α-NH_3^+	SIDE CHAIN
Alanine	2.34	9.69	—
Arginine	2.17	9.04	12.48
Asparagine	2.02	8.80	—
Aspartic acid	1.88	9.60	3.65
Cysteine	1.96	10.28	8.18
Glutamic acid	2.19	9.67	4.25
Glutamine	2.17	9.13	—
Glycine	2.34	9.60	—
Histidine	1.82	9.17	6.00
Isoleucine	2.36	9.60	—
Leucine	2.36	9.60	—
Lysine	2.18	8.95	10.53
Methionine	2.28	9.21	—
Phenylalanine	1.83	9.13	—
Proline	1.99	10.60	—
Serine	2.21	9.15	—
Threonine	2.09	9.10	—
Tryptophan	2.83	9.39	—
Tyrosine	2.20	9.11	10.07
Valine	2.32	9.62	—