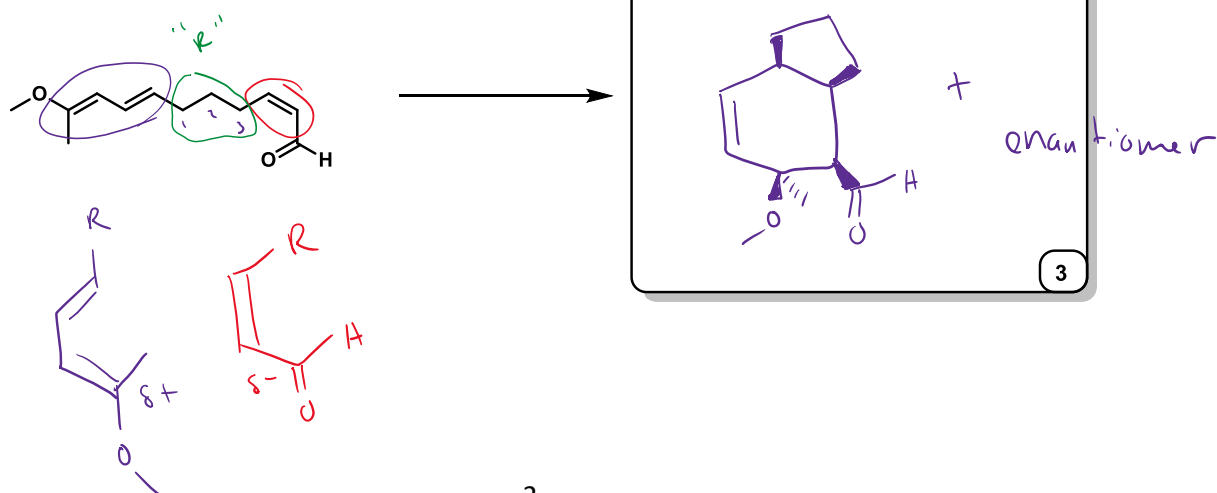
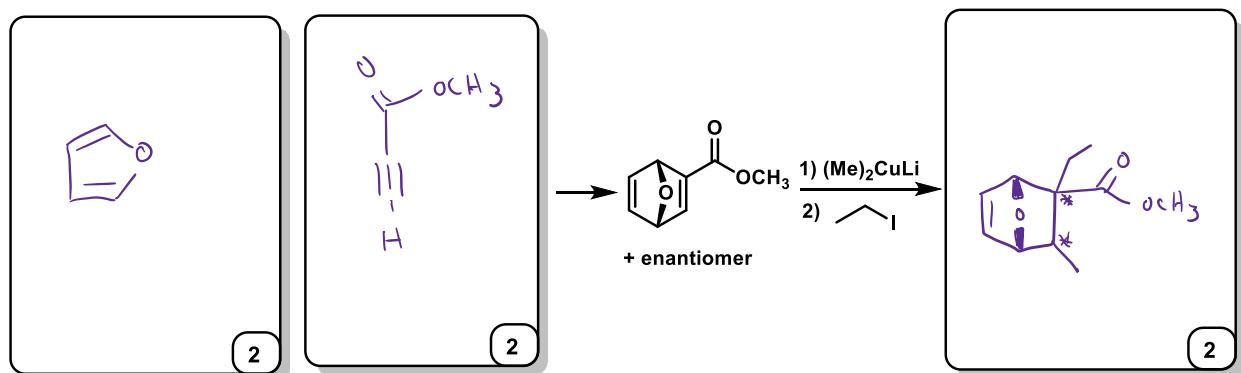
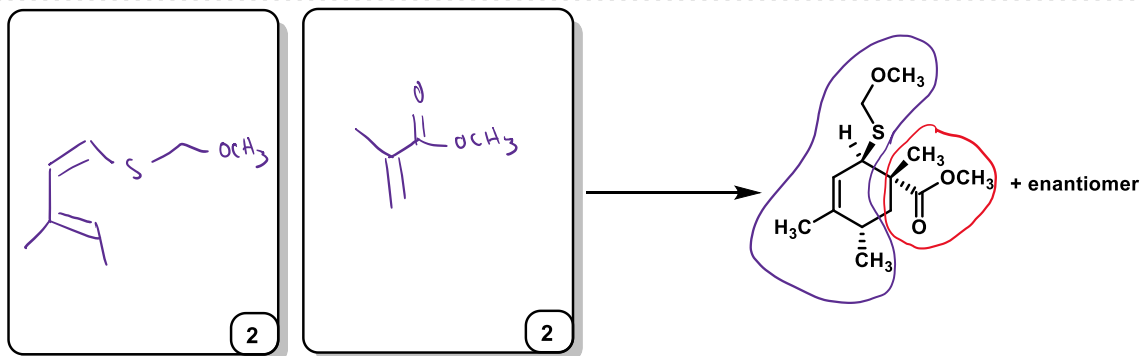
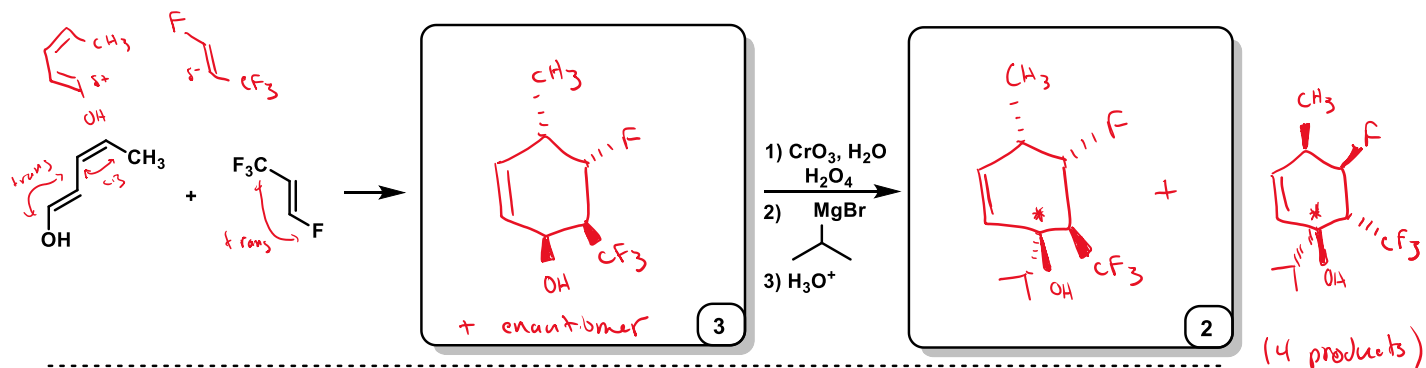


Amino acid tables are at the end of this document.

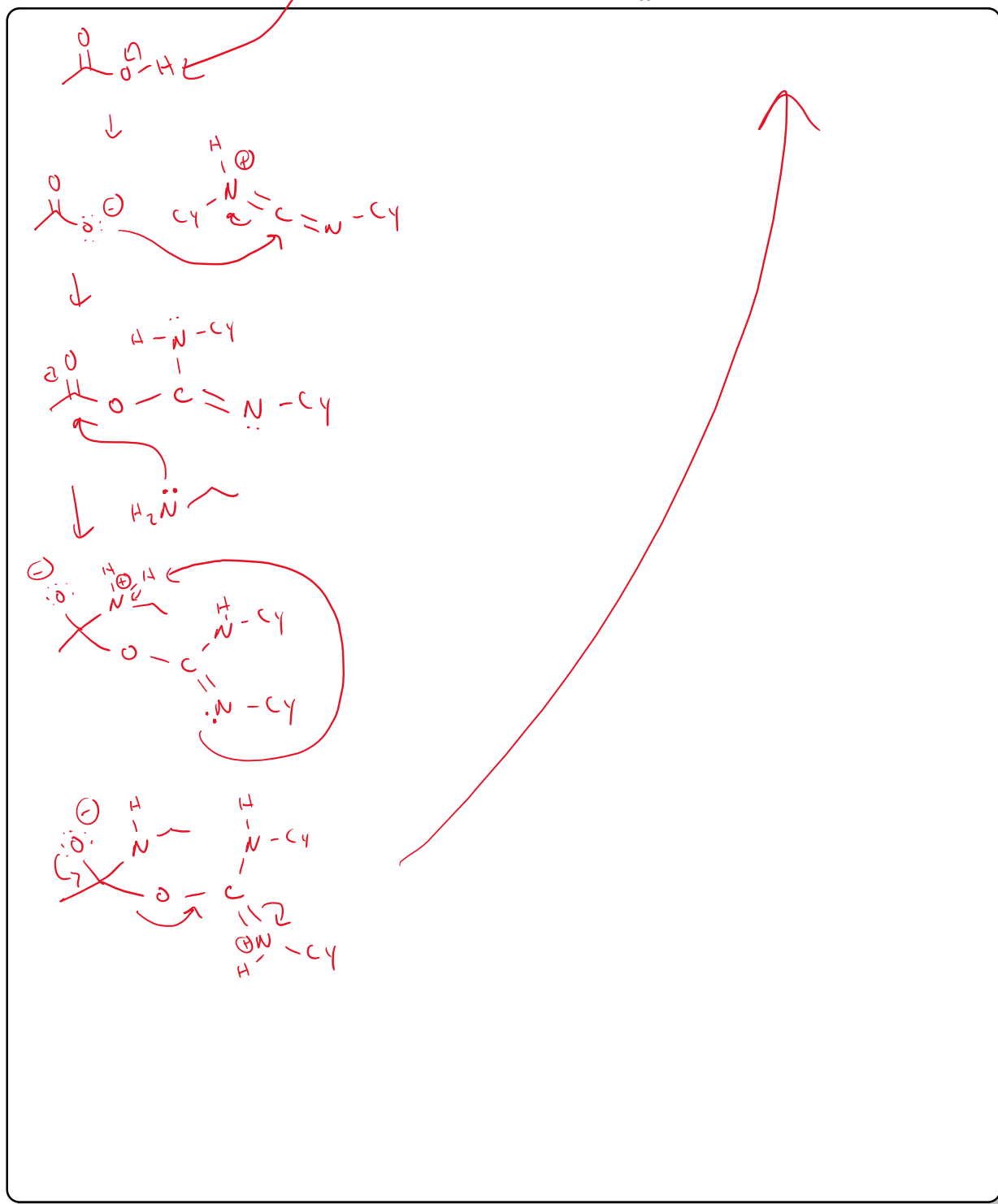
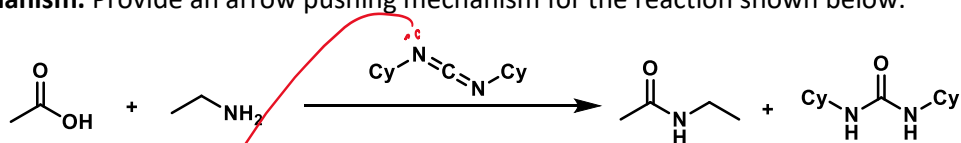
IA																				0															
1 H 1.008		IIA																		2 He 4.003															
3 Li 6.941		4 Be 9.012												III A 5 B 10.81		IVA 6 C 12.01		VA 7 N 14.01		VIA 8 O 16.00		VIIA 9 F 19.00		10 Ne 20.18											
11 Na 22.99		12 Mg 24.31		IIIB		IVB		VB		VIB		VIIB		VIIIB				IB		IIB		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)

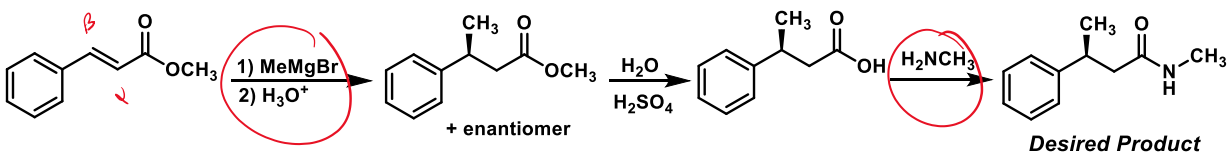
1. **Quick Synthesis.** Fill in the boxes with either the correct reagents or products. Please be sure to indicate stereochemistry (where appropriate) and steps, if needed.



2. **Mechanism.** Provide an arrow pushing mechanism for the reaction shown below.



3. **Flawed Synthesis.** Below you will find a synthesis that will not ultimately lead to the **Desired Product**. In the first box, describe the flaw(s) inherent in the synthetic route presented. In the second box, provide a new synthetic route that will lead to the **Desired Product**.



would attack
C=O
instead of
β position

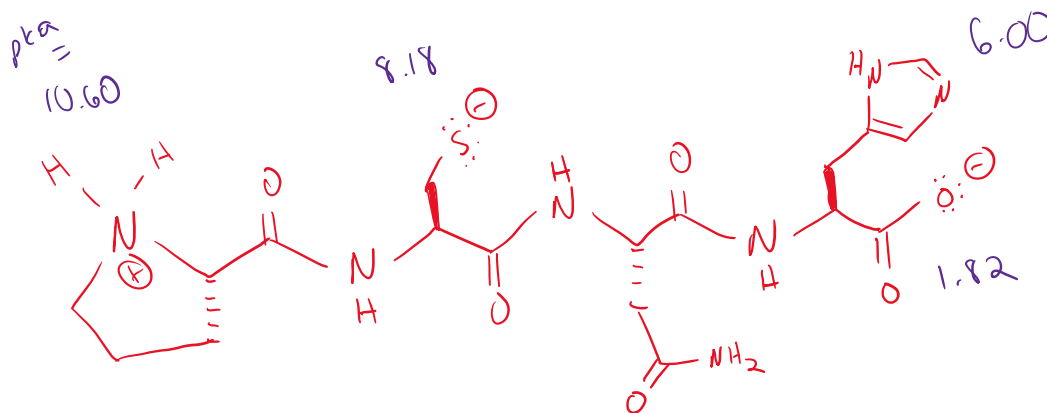
won't directly
make amide
w/ carboxylic acid

1) $(\text{CH}_3)_2\text{CuLi}$
2) H_3O^+

$\text{H}_2\text{N}-\text{CH}_3$
DCC

4. **Peptide Structure.** In the box, provide the major form of the following tetrapeptide at the indicated pH: Pro – Cys – Asn – His.

Proline - Cysteine - Asparagine - Histidine



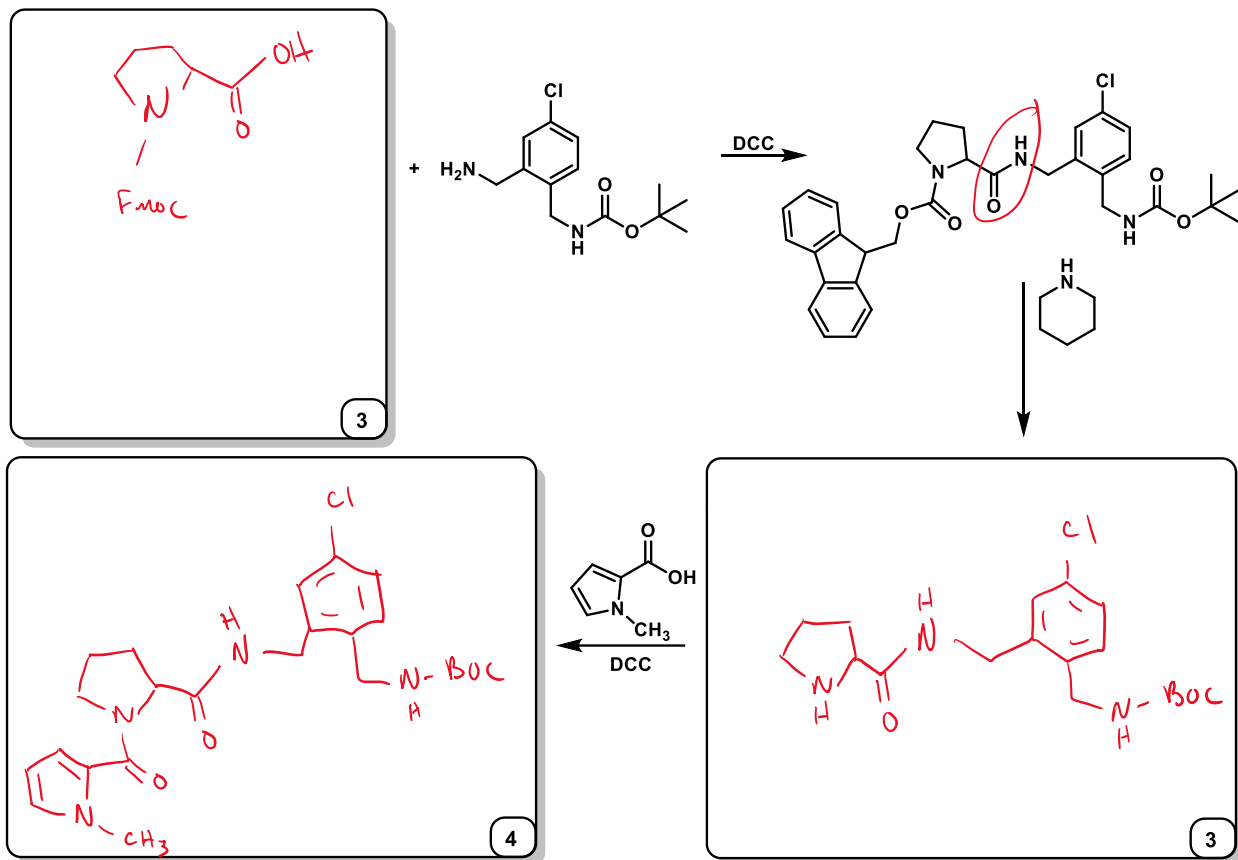
Provide the major form at pH = 9.5

pKa above 9.5 → protonated
below → deprot.

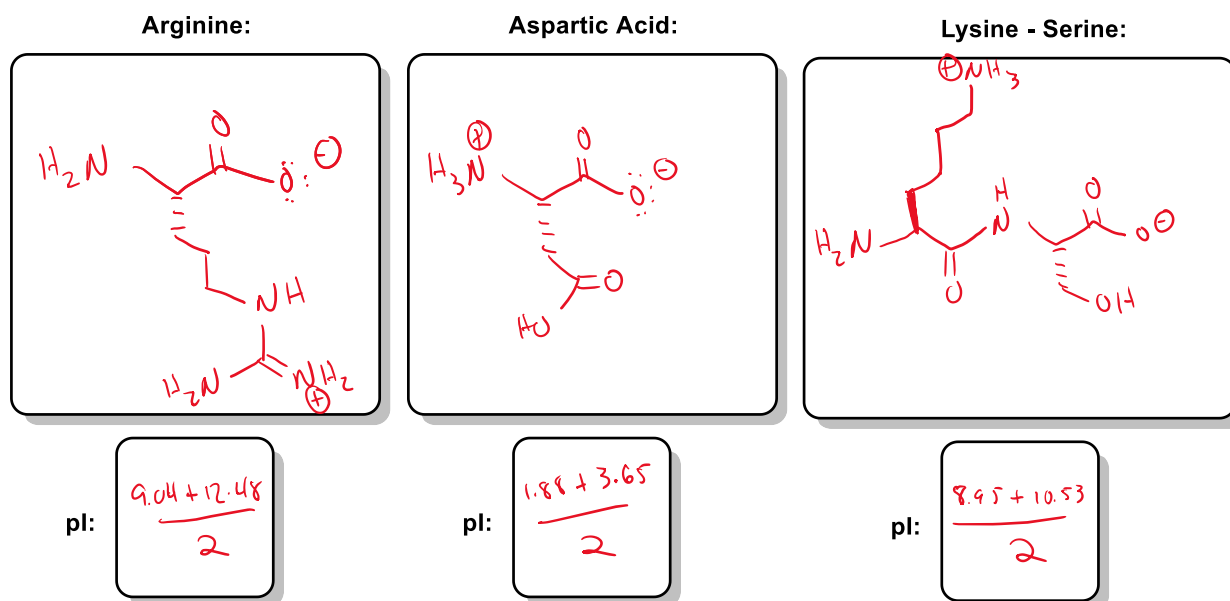
IA																				0				
1 H 1.008	IIA																			2 He 4.003				
3 Li 6.941	4 Be 9.012											IIIA	IVA	VA	VIA	VIIA	10 Ne 20.18							
												5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00								
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95							
		IIIB	IVB	VB	VIB	VIIB	VIII B	IB	IIB	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90										
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)

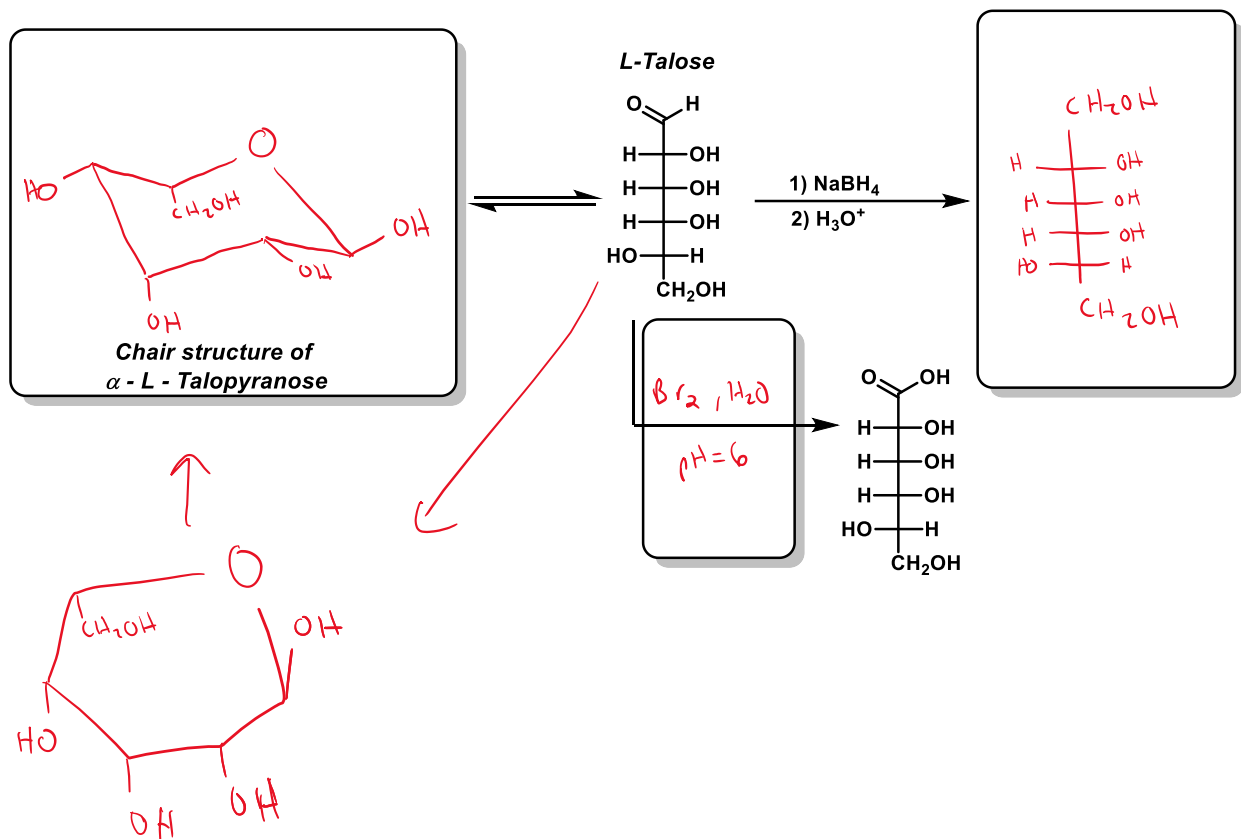
5. **Guided Synthesis.** Fill in the boxes with the missing starting material, intermediate and final product of the synthesis below.



6. **Isoelectric Point.** Using the charts found at the end of the exam, provide the zwitter ion form of each of the following amino acids / peptide chains, in addition to their respective isoelectric points (12 pts)



7. **Carbohydrate Structure.** First, provide the chair structure of the indicate pyranose sugar based on the information provided. (hint – start with a Haworth projection) Then, provide either the reagents or the product of the two reactions stemming from the acyclic sugar. (10 points)



8. **Peptide Synthesis.** Provide a complete synthesis of the following tripeptide starting from the individual amino acids: Lysine – Methionine – Valine. You may use abbreviations for reagents and protecting groups, where appropriate.

Lysine - Methionine - Valine

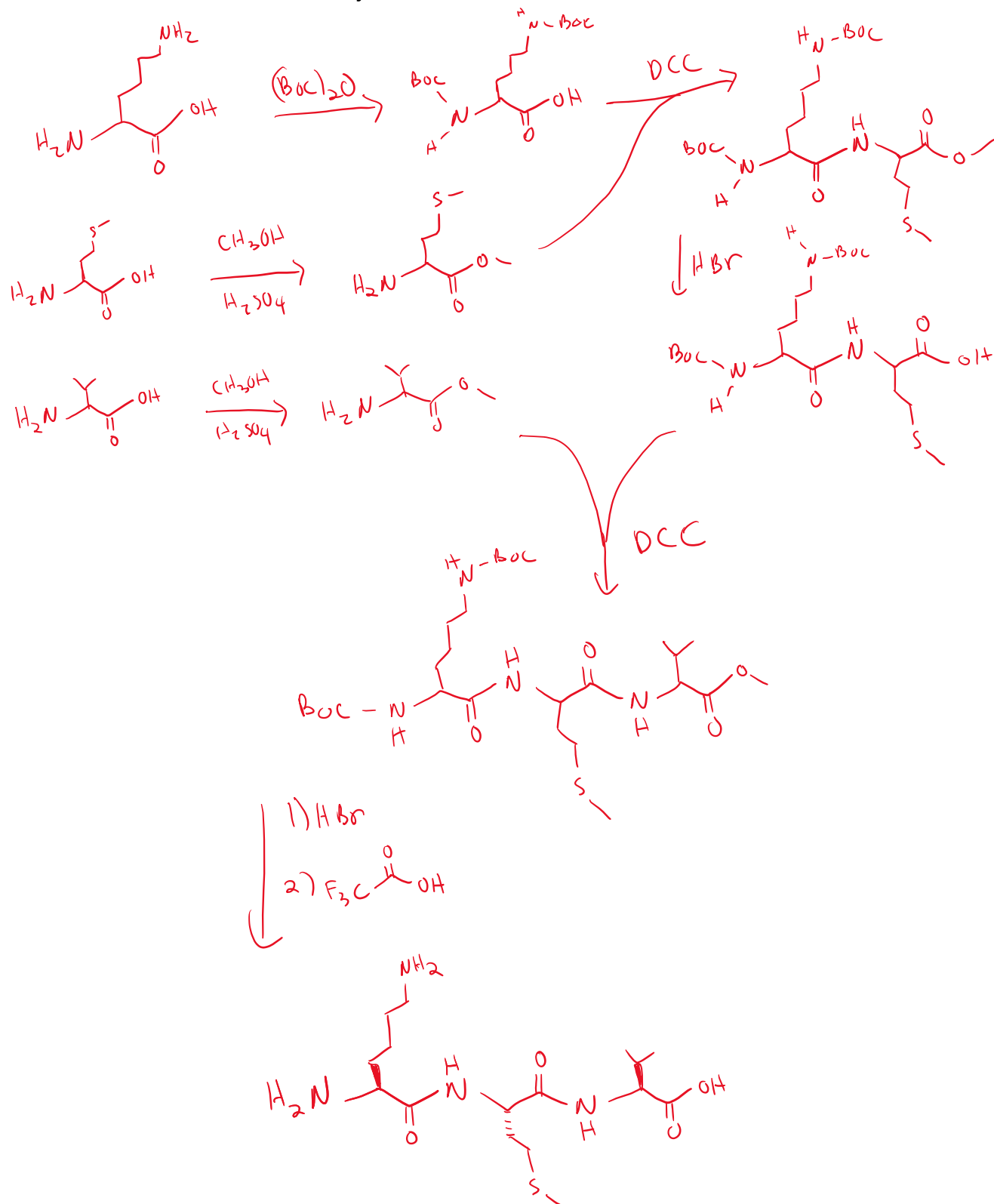


TABLE 25.1 THE STRUCTURES OF THE TWENTY NATURALLY OCCURRING AMINO ACIDS THAT ARE FOUND IN PROTEINS

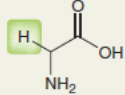
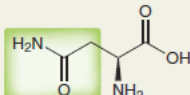
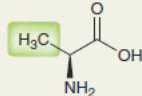
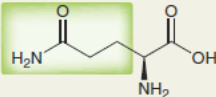
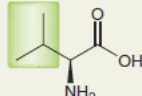
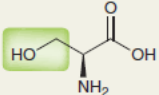
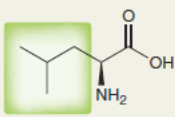
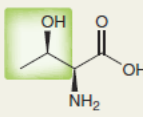
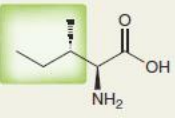
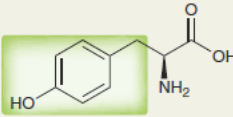
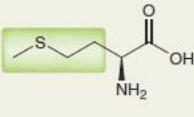
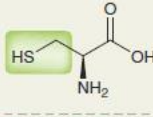
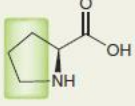
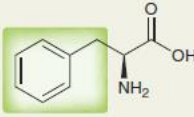
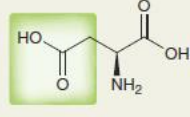
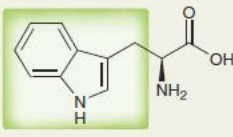
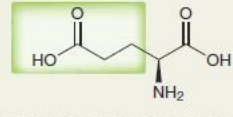
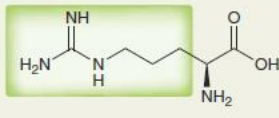
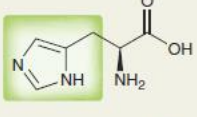
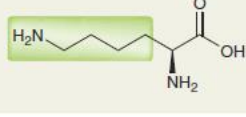
Name	Structure	Abbreviation	Name	Structure	Abbreviation
Amino acids with nonpolar side chains			Amino acids with polar side chains		
Glycine		Gly G	Asparagine		Asn N
Alanine		Ala A	Glutamine		Gln Q
Valine		Val V	Serine		Ser S
Leucine		Leu L	Threonine		Thr T
Isoleucine		Ile I	Tyrosine		Tyr Y
Methionine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