Answers to Puzzles of Chapter 21
Amino Acids and Proteins

21.1 (a) cysteine (b) isoleucine, threonine (c) phenylalanine, tryptophan, tyrosine, histidine

21.2 (a) $H_3\overset{+}{N}CH_2CH_2CO_2^-$ (b) $H_3\overset{+}{N}CH_2CH_2CO_2H$ (c) $H_2NCH_2CH_2CO_2^-$

21.3 (a)

$H_3\overset{+}{N}$-CH(CH_2SH)-CO_2H	$H_3\overset{+}{N}$-CH(CH_2SH)-CO_2^-	$H_3\overset{+}{N}$-CH(CH_2S^-)-CO_2^-	H_2N-CH(CH_2S^-)-CO_2^-

$\longleftarrow$ $[H^+]$ $\sim 10^{-2}$ $\sim 10^{-9}$ $\sim 10^{-11}$

(b) isoelectric point = $-0.5 \cdot \log(2 \times 10^{-2})(5 \times 10^{-9})$ = pH 5.0
(c) The – on its side chain repels, destabilizes, and strengthens the <u>base e's</u> of the conjugate base.

21.4 (a)

$H_3\overset{+}{N}$-CH($(CH_2)_4\overset{+}{N}H_3$)-$CO_2H$	$H_3\overset{+}{N}$-CH($(CH_2)_4\overset{+}{N}H_3$)-$CO_2^-$	H_2N-CH($(CH_2)_4\overset{+}{N}H_3$)-$CO_2^-$	H_2N-CH($(CH_2)_4NH_2$)-CO_2^-

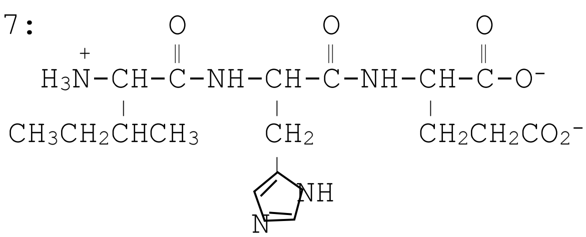
$\longleftarrow$ $[H^+]$ $\sim 10^{-2}$ $\sim 10^{-9}$ $\sim 10^{-10}$

(b) H_2N-CH($(CH_2)_4\overset{+}{N}H_3$)-$CO_2^-$

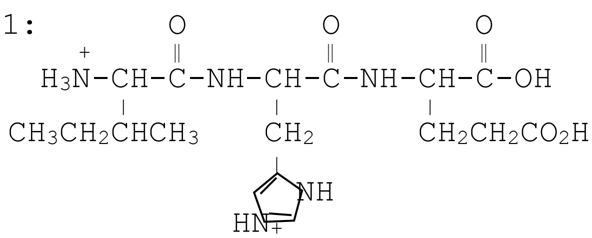
(c) isoelectric point = $-0.5 \cdot \log(1 \times 10^{-9})(3 \times 10^{-10})$ = pH 9.3; basic as expected.

21.5 Cys-Tyr-Phe-Gln-Asn-Cys-Pro-Arg-Gly-NH_2

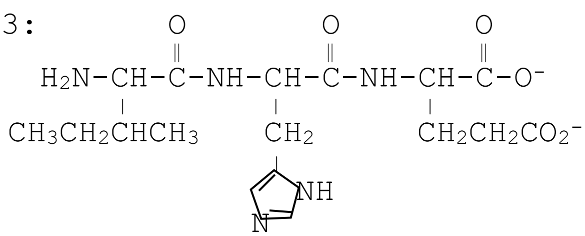
21.6 at pH 7:



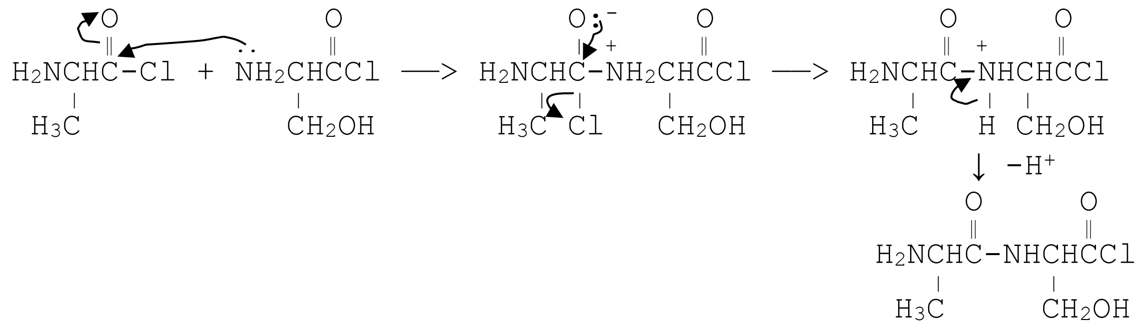
at pH 1:

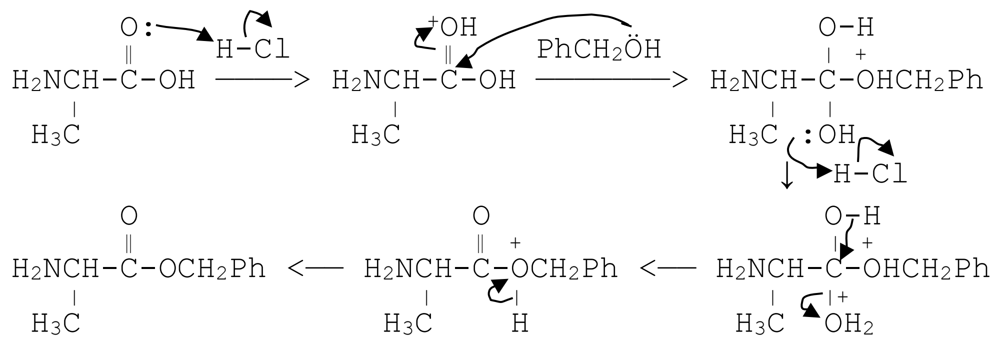


at pH 13:



21.7 His-Trp-Arg-Ile-Lys-Met

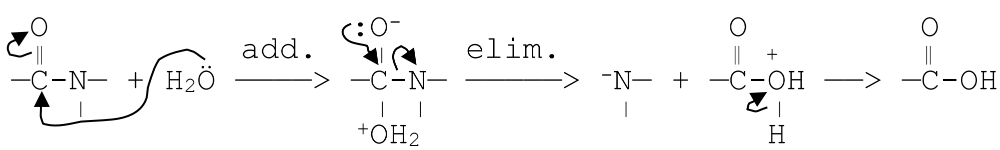
21.8 

21.9 

21.10 Without this hydroxy group the DNA could enhance neither the electrophile nor the leaving group of the amino acid-DNA complex by H "bonding".

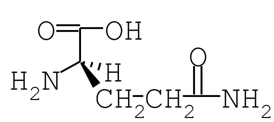
21.11 The 2° & 3° structures change in the slightly polar ether, because many nonpolar side chains turn inside out, and many polar side chains turn outside in.

21.12 (a) nonpolar (b) globular (c) inside, where they can attract the ion or polar molecule (d) outside, where they can attract the main, nonpolar parts of the membrane

21.13
(a) 

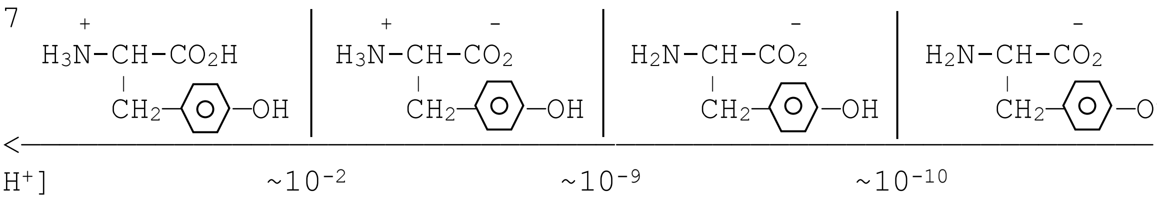
(b) A weaker nuc for the addition; a poorer, stronger leaving group from the elimination.

21.14 (a) + (b) none
(c) Aspartic acid & glutamic acid: the – on their side chains attracts the + on lysine & arginine.

21.15 

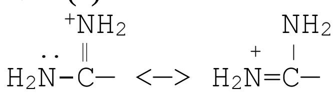
21.16 Z-CH-CO_2H
|
NH_2

The less polar $CHCl_3$ solvates ions poorly, so the less polar unionized form is more soluble in it.

21.17
(a)


(b) isoelectric point = $-0.5\cdot\log(6 \times 10^{-3})(8 \times 10^{-10})$ = pH 5.7

21.18 (a) Resonance makes both NH_2 groups equivalent, so either is equally likely to lose a H^+:



(b) Resonance like that above makes both N's equivalent, so either is equally likely to lose a H^+.

21.19 methionylmethionylleucine, methionylleucylmethionine, leucylmethionylmethionine

21.20 Gly-Ala-Leu-Leu-Phe

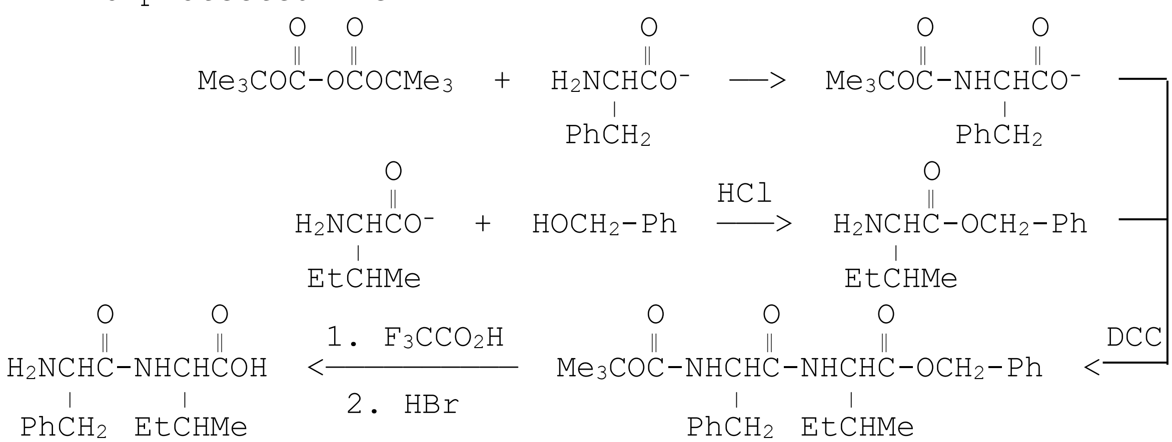
21.21 (a)

Phe —> N-protected Phe

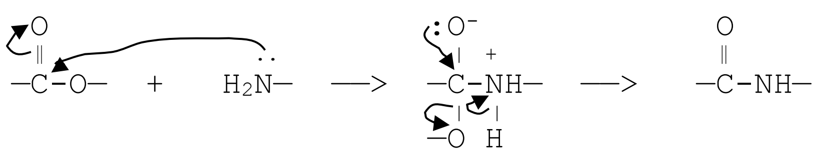
Ile —> C-protected Ile

$\xrightarrow{\text{DCC}}$ protected Phe-Ile —> Phe-Ile

(b)

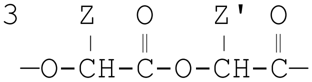


21.22



Met-Ala-tRNA Cys-tRNA Met-Ala-Cys-tRNA

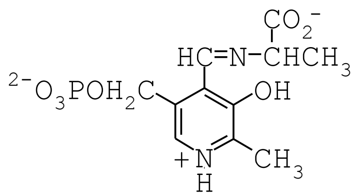
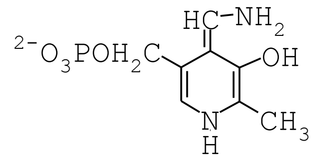
21.23

(a)


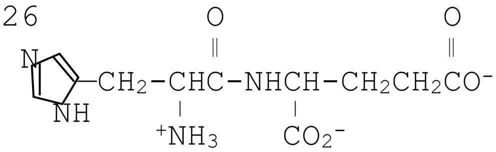
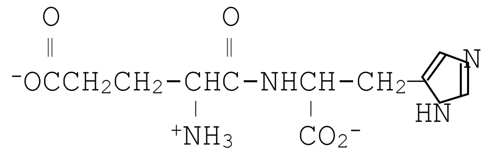
(b) More susceptible: esters are more reactive in addition-elimination reactions than amides.

(c) No: without regular NH groups along the chain it would not have the regular intramolecular H "bonding".

(d) Very different function because its secondary and tertiary structures would be very different.

21.24 **B** ≡  **C** ≡ 

21.26

(a)  (b) 

21.27 (a) hair, skin, muscle, fingernail, tendon (b) fibrous (c) they don't dissolve in water

21.28

Basicity of conjugate bases: $\text{Me-}\underset{}{\overset{:NH_2}{\overset{|}{C}}}\text{HCO}_2^- > \text{Me-}\overset{:NH_2}{\overset{|}{C}}\text{HCO}_2\text{Me}$

because the - of the first base destabilizes the <u>base e's</u>.

So in acidity: $\text{Me-}\overset{^+NH_3}{\overset{|}{C}}\text{HCO}_2^- < \text{Me-}\overset{^+NH_3}{\overset{|}{C}}\text{HCO}_2\text{Me}$. So K_a of ester is higher.

21.29

$$\text{isoelectric point} = \frac{\text{p}K_a \text{ of Asp's side chain} + \text{p}K_a \text{ of Asp's } \alpha\text{-NH}_3}{2}$$

$$= \frac{4.0 + 9.7}{2} = 6.8$$

7/05