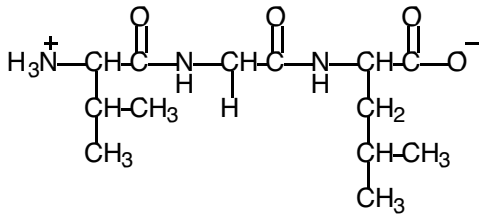
Homework from Lecture 2 Selected answers

18.20

Peptides that contain neither acidic nor basic amino acids have a net charge of +1 at pH = 1 because both the *N*-terminal amino group and the *C*-terminal carboxylic acid group are protonated. At pH = 11, these peptides have a net charge of –1, because the *N*-terminal group is uncharged and the *C*-terminal group is a carboxylate anion. At pH=1, these peptide have a net charge of zero.

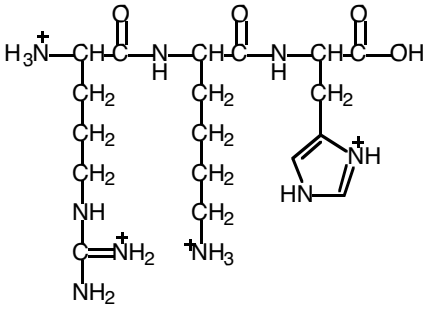
a)



Val-Gly-Leu
at Ph=7.0

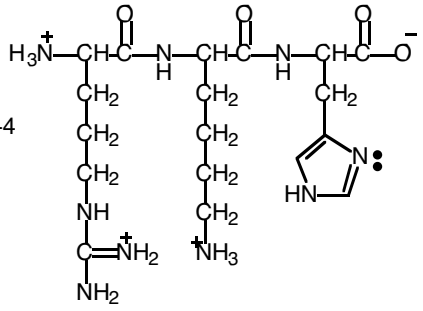
Net charge at pH=1: +1 Net charge at pH = 7: 0 Net charge at pH = 11: –1

b)

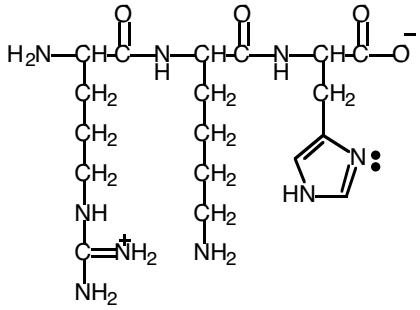


Arg–Lys–His
at pH = 1.0

Net Charge: +4

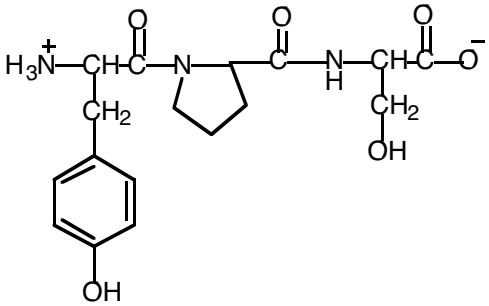


at pH = 7.0
Net Chrage
+2



at pH = 11.0
Netcharge: 0

c)

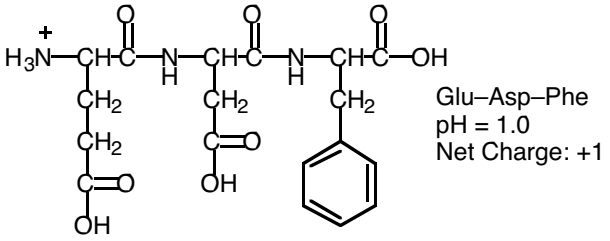


Tyr–Pro–Ser
at pH =7.0

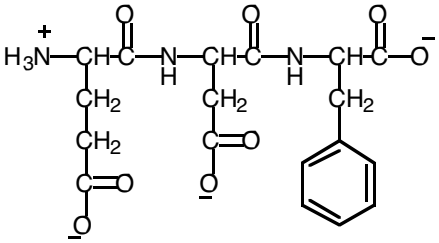
Net charge at pH=1: +1 Net charge at pH = 7: 0 Net charge at pH = 11: –2

At pH = 11, the phenol –OH (pK_a = 10.0 – 10.3) is ionized and is anionic

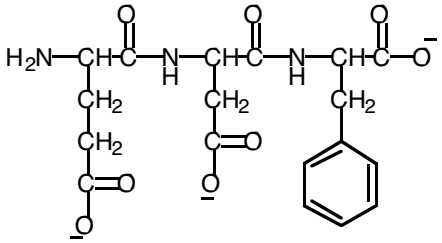
d)



Glu–Asp–Phe
pH = 1.0
Net Charge: +1

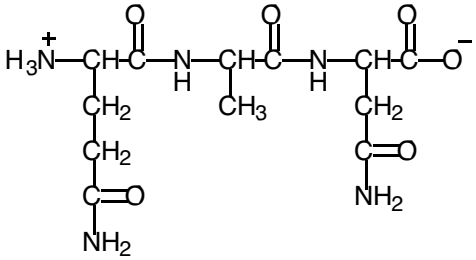


pH = 7.0
Net Charge: –2



pH = 11.0
Net Charge: –3

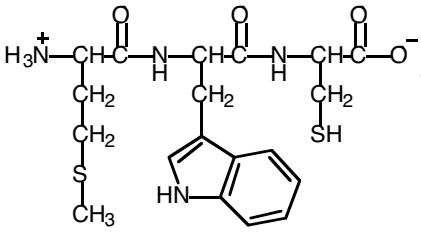
e)



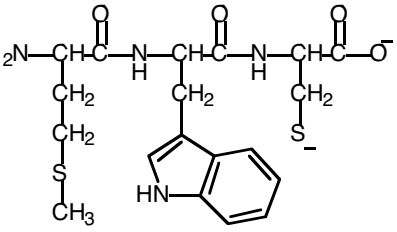
Gln–Ala–Asn
at pH = 7.0

Net charge at pH=1: +1 Net charge at pH = 7: 0 Net charge at pH = 11: –1

f)



Met–Trp–Cys
at pH = 7.0



at pH = 11.0

Net charge at pH=1: +1 Net charge at pH = 7: 0 Net charge at pH = 11: –2

The book does not clearly state that the thiol of Cys has a pK_a of 9.0 – 9.5. It's hydrogen is therefore not present at pH = 11.

18.50

(a) *Hydrophobic interactions* occur between hydrocarbon side chains of amino acids. In a protein, these side chains cluster in the center of the molecule to exclude water, and are responsible for the nearly spherical tertiary shape of globular proteins. Alanine and isoleucine take part in hydrophobic interactions.

(b) *Salt bridges* occur between negatively charged and positively charged amino acid side chain groups. They can stabilize the teriary structure of a protein by connecting two distant parts of a polypeptide chain or by pulling the protein backbone together in the middle of the chain. They can also stabilize quaternary structure by bridging together two polypeptide chains. Lysine and aspartate can form salt bridges.

18.64 c – The peptide is hydrolyzed into its component amino acids. At physiological pH (pH ≈ 7.4) the α-carboxylic acid and the side chain carboxylic acid of Asp are deprotonated. All amine groups are protonated.