

3.091 OCW Scholar

Self-Assessment Organic Materials

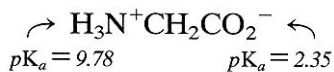
Supplemental Exam Problems for Study

2007 Final, Problem #5

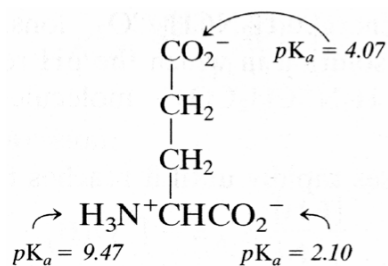
- (a) Chloroprene (or 2-chloro-1,3-butadiene in proper IUPAC nomenclature), $\text{CH}_2=\text{CCl}-\text{CH}=\text{CH}_2$, can be reacted by addition polymerization to form polychloroprene (CR), also known as Neoprene™ (the name given to it by DuPont). The mer unit of CR is $(-\text{CH}_2-\text{CCl}=\text{CH}-\text{CH}_2-)_n$. The process is initiated with the radical, I^\bullet . Draw a segment of isotactic CR showing two repeat units. Place the radical initiator at the left end of the dimer and indicate the location of the unpaired electron.
- (b) Calculate the degree of polymerization, n , of CR with a molecular weight of $3.091 \times 10^5 \text{ g mol}^{-1}$?
- (c) CR has been dubbed the world's first *synthetic rubber*, which in polymer circles is termed an *elastomer*. What structural feature of CR enables it to be made into an elastomer? Explain with the aid of a sketch that shows the molecular origin of the rubbery nature of the polymer.
- (d) Classify CR as either a thermoset or a thermoplastic, and with reference to its molecular structure assess its recyclability.

2008 Final Exam, Problem #4

The skeletal structures of the two amino acids, glycine and glutamic acid, are given below along with the values of the relevant acid dissociation constants (pK_a).



glycine (Gly)



glutamic acid (Glu)

(a) For an aqueous solution of glycine (Gly) alone, calculate the value of pH at which the ratio of the concentration of neutral glycine zwitterion to the concentration of deprotonated anion is 10^{-4} .

(b) Draw the skeletal structure of glutamic acid (Glu) when it is solvated in an aqueous solution under each of the following conditions.

(i) $pH = 1.5$

(ii) $pH = 14$

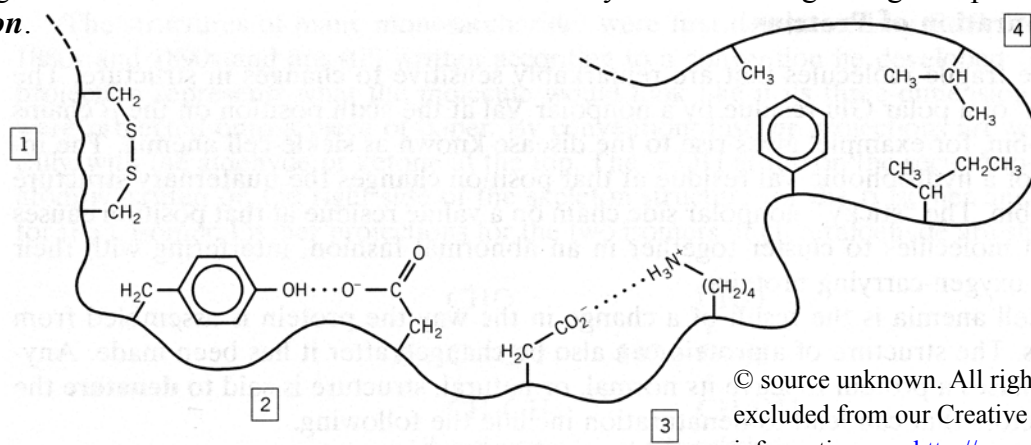
(iii) $pH = pI$, the isoelectric point

Problem #4 (continued)

(c) Calculate the value of pH at which glutamic acid (Glu) exists as the neutral zwitterion.

(d) Draw the skeletal structure of the dipeptide, Glu-Gly, when it is solvated in an aqueous solution of extreme acidity, i.e., $pH < 1$.

(e) The figure below shows various features of the tertiary structure along a length of protein *in aqueous solution*.



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For each of the following changes from the conditions that sustain the structure shown above,

(1) identify the numbered site or sites at which the tertiary structure is affected and

(2) explain the potential impact on the conformation of the protein.

① increase in pH

② increase in concentration of detergent

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