

## CONCEPT: NON-IONIZABLE VS IONIZABLE R-GROUPS

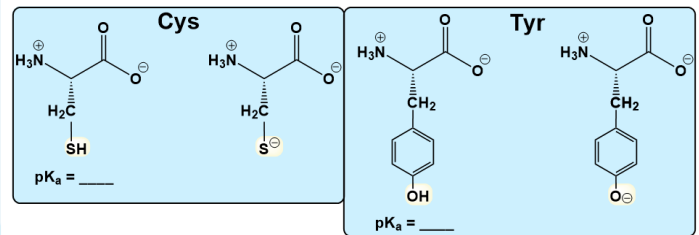
- Non-ionizable R-Groups: \_\_\_\_\_ groups \_\_\_\_\_ acid/base reactions ( $H^+$  transfers).
  - Only have \_\_\_\_\_  $pK_a$  values (R-group does \_\_\_\_\_ have a  $pK_a$ ).
  - \_\_\_\_\_ amino acids have non-ionizable R-groups.
- Ionizable R-Groups: \_\_\_\_\_ group resulting from acid/base reactions ( $H^+$  transfers).
  - Have \_\_\_\_\_  $pK_a$  values (R-group does have a  $pK_a$ ; R-group  $pK_a$  sometimes called  $pK_R$ ).
  - Capable of forming \_\_\_\_\_ bonds.

**EXAMPLE:** Total the number of amino acids in each of the indicated ionization groups.

Amino Acid	$\alpha$ -COOH $pK_a$	$\alpha$ -NH <sub>3</sub> <sup>+</sup> $pK_a$	R-group $pK_a$
Alanine	2.4	9.7	
Arginine	2.2	9.0	12.5
Asparagine	2.0	8.8	
Aspartic Acid	2.1	9.8	3.9
Cysteine	1.7	10.8	8.3
Glutamic Acid	2.2	9.7	4.3
Glutamine	2.2	9.1	
Glycine	2.3	9.6	
Histidine	1.8	9.2	6.0
Isoleucine	2.4	9.7	
Leucine	2.4	9.6	
Lysine	2.2	9.0	10.5
Methionine	2.3	9.2	
Phenylalanine	1.8	9.1	
Proline	2.1	10.6	
Serine	2.2	9.2	
Threonine	2.6	10.4	
Tryptophan	2.4	9.4	
Tyrosine	2.2	9.1	10.1
Valine	2.3	9.6	

Total # of Amino Acids:

☐ + Charged at pH 7. -----  
☐ = Charged at pH 7. -----  
☐ Ionizable but mostly uncharged at pH 7. -----  
☐ Non-ionizable R-group. -----



**PRACTICE:** Which pair of amino acids could form an ionic bond between the R-groups?

- a) Asp & Glu      b) Gly & Leu      c) His & Arg      d) Cys & Lys

## Memorizing Ionization of R-Groups

- Only \_\_\_\_\_ amino acids have ionizable R-groups.
  - Includes all charged amino acids plus \_\_\_\_\_ (\_\_\_\_) & \_\_\_\_\_ (\_\_\_\_).

**EXAMPLE:**

Amino Acids with Ionizable R-Groups:

Y C D E K R H: Yucky Crazy Dragons Eat Knights Riding Horses

Mostly uncharged at pH 7, but are likely ionized at other pHs.