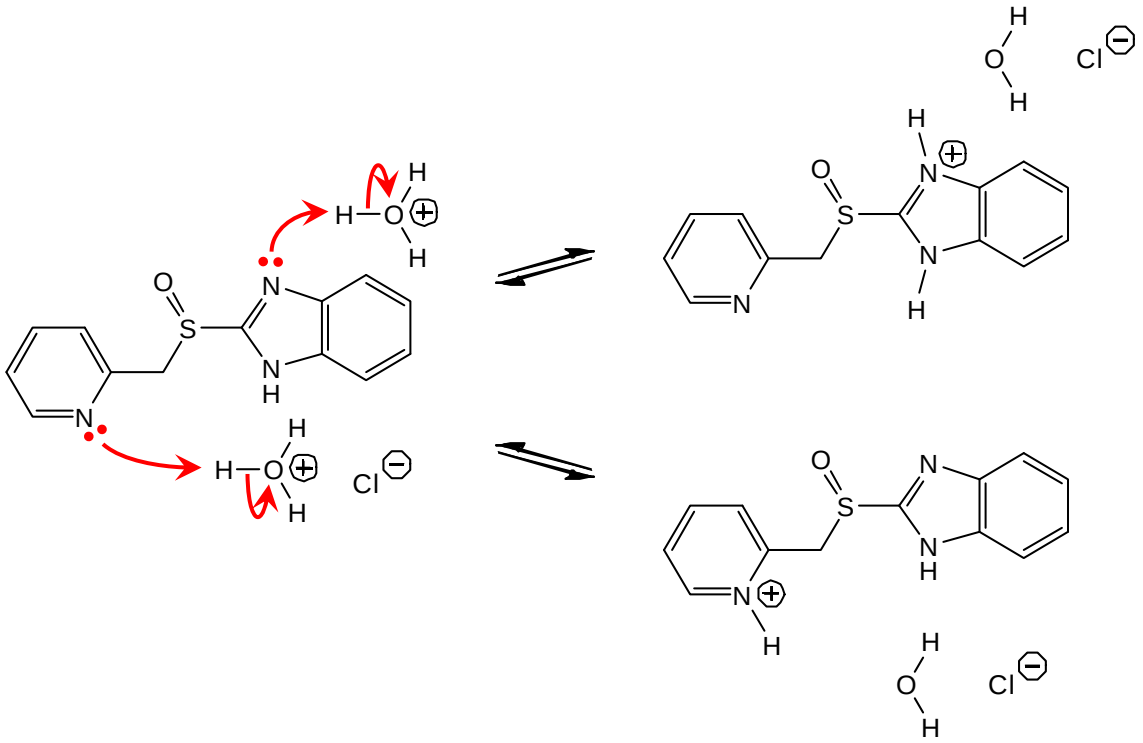
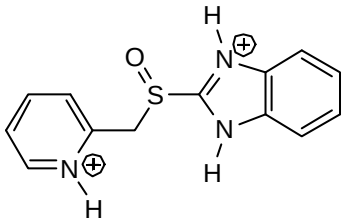
At-Home Exercise Solutions
The Pharmacology of Organic Acids and Bases

a.

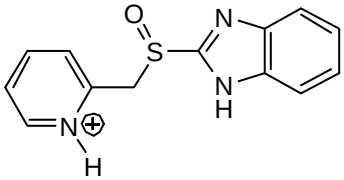


Here I've included the chloride counterions, but in drawing mechanisms it is common to leave out things that don't change, so you could omit the Cl^- if you want.

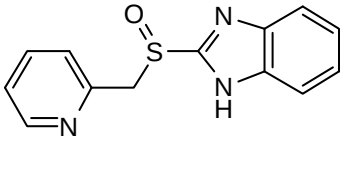
b. At pH = 3, the stomach is more acidic than the pK_a's of both the left and right sides of the molecule. (Actually pH = 3 is an upper bound for the pH of the stomach; it can be as low as pH = 1.) Under those conditions, both sides will be protonated. However, at pH = 4.5, the pH is still lower than the pyridine (left) side of the molecule, but higher than the right (benzimidazole) side; so the right side will deprotonate. At pH = 6, both sides will be deprotonated.



pH < 4

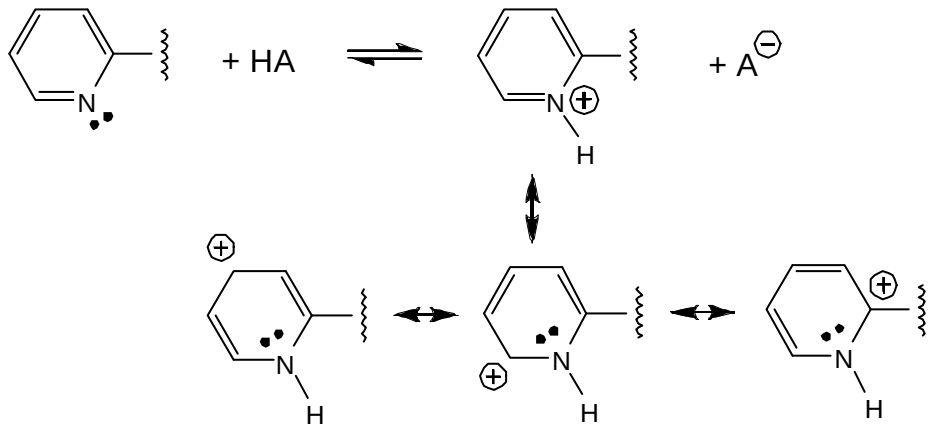


4 < pH < 5



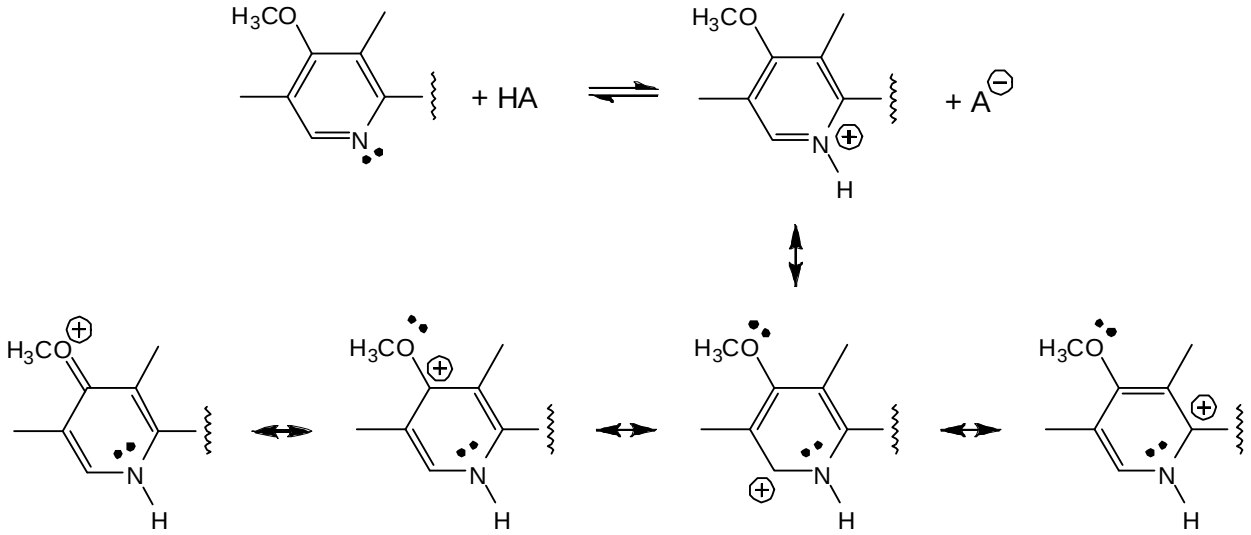
pH > 5

c. The pyridine ring in timoprazole is already a fairly good base because the charge in its conjugate acid is stabilized by resonance:



resonance structures

The bottom three resonance structures above are okay; they delocalize charge to more electropositive atoms, but each one has an unfilled octet (on each charged carbon), so they are minor resonance structures. Omeprazole has more resonance and more charge delocalization because of the oxygen substituent:



The left-hand resonance structure is another major one. This should push the acid-base equilibrium to the right, make omeprazole a better base than timoprazole, and increase the pK_a of omeprazole's conjugate acid—making it so that omeprazole is protonated even at pH = 7.