Gen-Chem #4: Acid-Base Basics

1.) Hey, gang! Now that we've dabbled a bit with structure-drawing, let's tackle another important skill we need for our organic toolbox: Acid-Base Chemistry. Below are a bunch of acid-base reactions at equilibrium. The question is, what side is favored at equilibrium? Well, that's your job to figure out: Using the 5 acid-base rules we've discussed, tell me ***which way*** the equilibrium is favored. I have full faith in you ☺.

*Remember the 5 rules: Size, electronegativity, hybridization, resonance, and inductive effect

$$H_2O + HS^- \rightleftharpoons OH^- + HS_2$$

Size

$$H_3As + H_2P^- \rightleftharpoons H_2As^- + H_3P$$

Size

$$OH^- + NH_3 \rightleftharpoons NH_2^- + H_2O$$

Electronegativity

Hybridization

$$Br^- + HNO_2 \rightleftharpoons HBr + NO_2^-$$

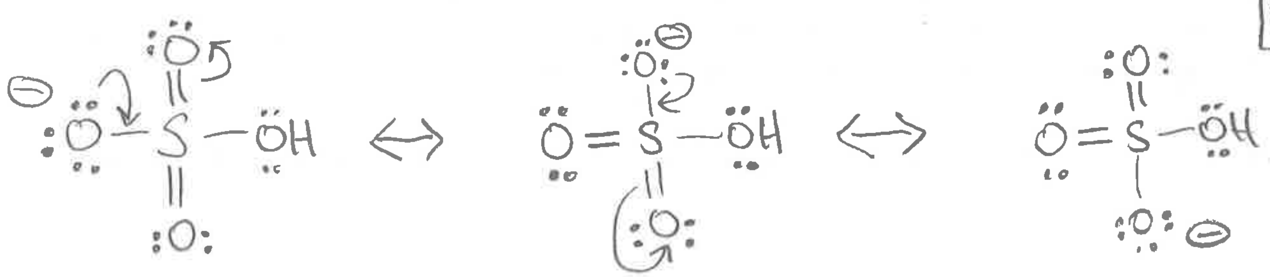
HBr is such a strong acid

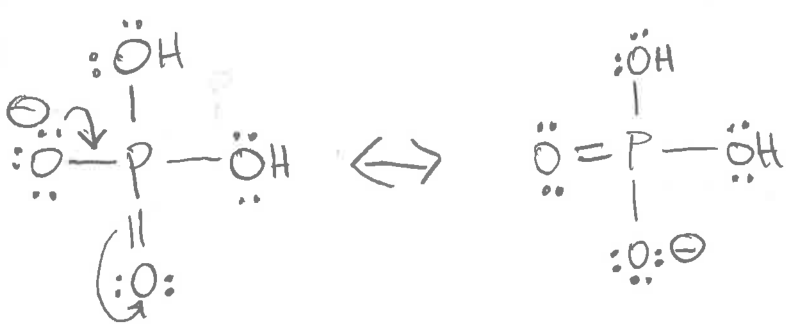
$$H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$$

Very good Resonance in H_2SO_4

2.) Well done, but on to the next one: Here, you need to ***draw*** resonance structures for the **conjugate bases** of H_2SO_4 and H_3PO_4 (**HSO_4^-** and **$H_2PO_4^-$**, respectively). Afterwards, flex that acid-base knowledge of yours and provide a BRIEF explanation as to why H_2SO_4 is a ***stronger*** acid than H_3PO_4 (said another way, HSO_4^- is a more stable conjugate base than $H_2PO_4^-$, right? But, I bet you were already thinking that).

$HSO_4^{\ominus}$

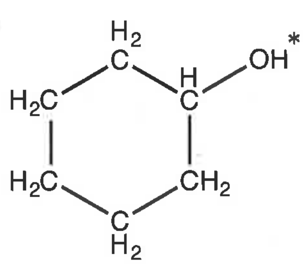


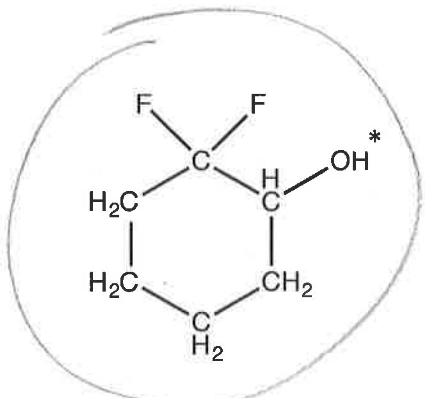


* There is more resonance in $HSO_4^{\ominus}$ than $H_2PO_4^{\ominus}$. Therefore $HSO_4^{\ominus}$ is a weaker, more stable conjugate base *

3.) All right, one more stop on this worksheet. Displayed below will be sets of 2 structures, both containing a starred (*) hydrogen. Circle the structure with the more acidic hydrogen, and then let's call it a wrap. Finish strong!

a.)

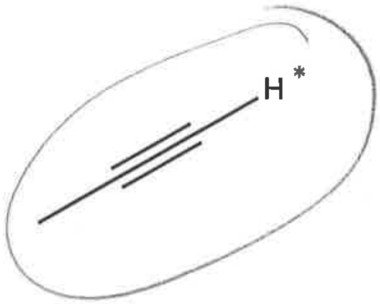




Inductive effect

Hybridization

b.)



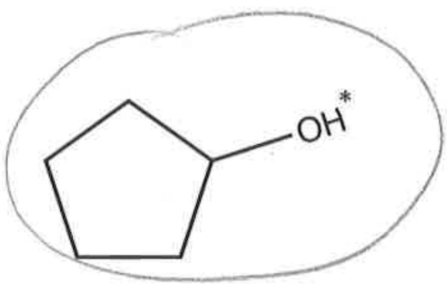
c.)

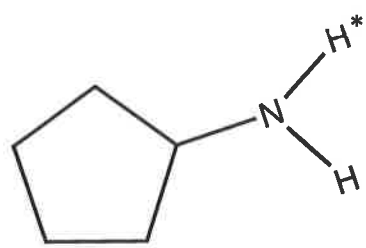
*HF

*$HClO_3$

Resonance

d.)





Electronegativity