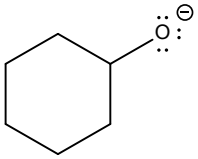
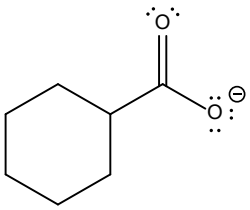
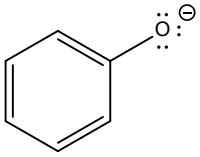
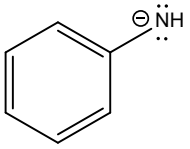
Answers to Exercise 12.1
Conjugate Acid-Base Pairs

1.

(a) 

(b) 

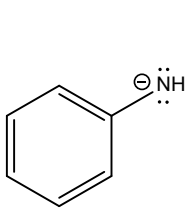
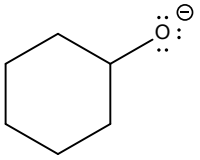
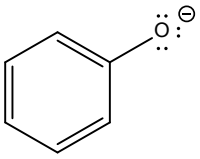
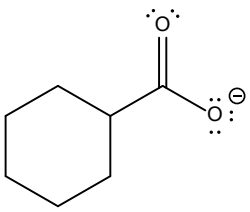
(c) 

(d) 

2.

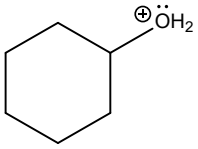
(a) $pK_a \approx 15$ (b) $pK_a \approx 5$ (c) $pK_a \approx 10$ (d) $pK_a \approx 28$

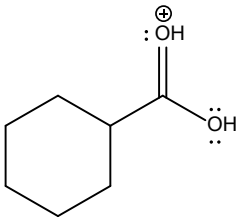
3. strongest base weakest base

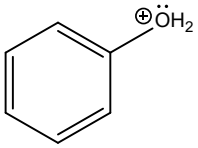





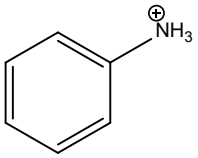
Strength of a base is inversely proportional to strength of its conjugate acid. Since pK_a is a measure of acid strength, we can rank the acids from strongest to weakest: carboxylic acid ($pK_a \approx 5$) > phenol ($pK_a \approx 10$) > alcohol ($pK_a \approx 15$) > amine ($pK_a \approx 28$). The ranking of conjugate base strength will be the opposite: conjugate base of amine > conjugate base of alcohol > conjugate base of phenol > conjugate base of carboxylic acid.

4.

(a) 

(b) 

(c) 

(d) 

5. Aniline ($C_6H_5NH_2$) is expected to be the strongest base because N is less electronegative than O therefore it will be better at sharing its electrons. When looking at the four conjugate acids, we see that its conjugate acid has a positive charge on N whereas the other conjugate acids have positive charges on the more electronegative O.

6. The pK_a value for the conjugate acids would be needed.

The strength of a base is inversely proportional to the strength of its conjugate acid. If aniline ($C_6H_5NH_2$) is indeed the strongest base of the four then its conjugate acid will have the highest pK_a value (indicating that $C_6H_5NH_3^+$ is the weakest acid of the four conjugate acids).