

Exercise 12.2
 K_a , pK_a , K_b and pK_b

1. In a conjugate acid-base pair, the K_a of the conjugate acid and the K_b of the conjugate base are related by the formula $K_a \cdot K_b = K_w$.
 K_w varies with temperature. At 25°C, $K_w = 10^{-14}$.
- (a) Recognizing that $pAnything = -\log(Anything)$, use log rules to demonstrate that $pK_a + pK_b = pK_w$ and that, at 25°C, $pK_a + pK_b = 14$.

- (b) Formic acid has a pK_a value of 3.74. Calculate the K_a value for formic acid.

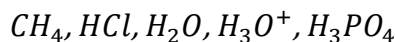
- (c) Formic acid (HCO_2H) is a carboxylic acid with one hydrogen atom attached to the carbon atom. Draw both formic acid and its conjugate base.

- (d) The conjugate base of formic acid is called formate. Calculate the K_b and pK_b of formate at 25°C,. Label each of your structures in part (c) with the appropriate values for K_a , pK_a , K_b or pK_b at 25°C,. Please note that you do not have sufficient information to calculate all four values for each species.

2. Both K_a and pK_a values can be used to compare strength of acids. To emphasize the difference between how these two scales work, complete the following table.

Relative Strength	pK_a	K_a	Acid
Strong		1×10^7 (10,000,000)	
Border between strong and weak	0		
Weak	2.1		
Very weak		1×10^{-14} (0.000000000000001)	
So weak we don't call it an acid		1×10^{-48}	

For the "acid" column, choose between the following chemical formulas:



It's fine to write the remaining K_a values using scientific notation. The expansion of two K_a values was to emphasize whether K_a was getting larger or smaller. The last K_a value would have 48 zeroes in front of the 1; that was too many to fit in the table!

- 3.
- (a) Briefly explain how you could use either pK_a values or K_a values to determine which is a stronger acid between CH_3CH_2SH and CH_3CH_2OH .
- (b) Briefly explain how you could use either pK_a values or K_a values to determine which is a stronger base between CH_3CH_2SH and CH_3CH_2OH .