

CHEM 1202 - Homework # 6

ANSWER KEY

Acids & Bases # 1

Due Thursday, Mar 22, 2022 (by 6 PM)

Check the box to the right if you want your graded homework to be placed out in the public hall outside Prof. Weber's office. Otherwise, please indicate to pick up your homework from Prof. Weber in person.

1. (3 pts) Consider the following weak acids and their pK_a values:



(formic acid)
 $(pK_a = 3.75)$

B) OC(=O)O (hydrofluoric acid)
 $(pK_a = 3.1)$

C) OC(=O)O (carbonic acid)
 $(pK_a = 6.4)$

D) OB(O)O (hydrobromous acid)
 $(pK_a = 7.4)$

E) OS(=O)(=O)O (sulfurous acid)
 $(pK_a = 1.8)$

F) OC(=O)O (nitric acid)
 $(pK_a = -10)$

Which compound is the strongest acid (use letter)? F

The strongest acid has the lowest or most negative pK_a value.

Which compound is the weakest acid (use letter)? D

The weakest acid has the highest pK_a value.

Which compound has the strongest conjugate base (use letter)? D

The weakest acid has the strongest conjugate base.

2. (5 pts) What are the pH's for the following solutions?

a) 0.001 M HBr = 3.0

b) 1 M HNO₃ = 0.0

c) 1×10^{-7} M HCl = 7.0

d) 10 M NaOH = 15.0

e) 1×10^{-2} M KOH = 9.0

3. (4 pts) Calculate the pH of a 0.001 M solution of acid that has a pK_a of 5.0. Clearly show all your work and put a box around your answer.



$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{x \cdot x}{(0.001 - x)} \quad \text{assume } x \ll 0.001 \text{ due to small } K_a \text{ value} \quad \frac{x^2}{0.001} = 1 \times 10^{-5} \quad x = 1 \times 10^{-4}$$

$$x = 1 \times 10^{-4} = [H^+] \quad \boxed{\text{pH} = 4.0}$$

Note that x is only one order of magnitude smaller than the concentration (0.001 M), so the approximation just barely works.

4. (4 pts) What is the K_a value of a 1 M solution of carbonic acid (HA) that has a pH of 4? Clearly show all your work and put a box around your answer.



BUT, before you go any further, I've given you the pH of the solution in the problem. So you don't have to solve for x , you already know it! So all we have to do is take the anti-log of pH 4 to get the concentration of the H⁺ (and A⁻):

$[H^+] = \text{anti-log}(-4) = 1 \times 10^{-4}$ M (Substituting this into the equilibrium expression gives us:

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{1 \times 10^{-4}}{1 - 1 \times 10^{-4}} = 1 \times 10^{-4} \quad \text{so, } \boxed{K_a = 1 \times 10^{-4}} \quad \text{or } \text{p}K_a = -\log(K_a) = 4$$

Note that it is fine to drop the x in the $1 - x$ expression because x is much smaller than 1.

Chemistry 1003 Answers

Wolfgang Ostwald



Chemistry 1003 Answers:

Bakers' Helper; the Baking Industry Magazine ,1922 University of Michigan Official Publication ,1953
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