STRONG AND WEAK ACIDS

1. A strong acid is one which is virtually 100% ionised in solution; a weak acid is one which doesn't ionise fully in solution.

   In a solution of hydrochloric acid, the HCl is virtually 100% ionised to give hydrogen ions (or better, hydroxonium ions) and chloride ions. By contrast, in a solution of ethanoic acid, an equilibrium is set up in which most of the acid is still present in the un-ionised form, and only a small percentage has ionised to give hydrogen ions and ethanoate ions.

2. a) $pH = -\log_{10}[H^+]$

   b) (i) $[H^+] = 0.200$

   $pH = -\log_{10}[0.200]$

   $pH = 0.699$

   (Note: pHs are normally quoted to a maximum of 2 decimal places, so this would usually be given as 0.70. Don't worry about it. The general rule is to quote your answer to no more significant figures than your least accurate input. In this case, the hydrogen ion concentration is quoted to 3 significant figures, and so you are justified in quoting your answer to the same number of significant figures.)

   (ii) $[H^+] = 0.0100$

   $pH = -\log_{10}[0.0100]$

   $pH = 2.00$

   (iii) $[H^+] = 1.00$

   $pH = -\log_{10}[1.00]$

   $pH = 0$

   (The implication of this is that any solution of a strong acid with a concentration greater than 1 mol dm^{-3} will have a negative pH. Don't be put off by that!)

3. a) Either: $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

   or: $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

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b) Either:

$$K_a = \frac{[CH_3COO^-][H_3O^+]}{[CH_3COOH]}$$

or:

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

c) $pK_a = -\log_{10} K_a$

d) $K_a = 1.74 \times 10^{-5}$

$pK_a = -\log_{10}(1.74 \times 10^{-5})$

$pK_a = 4.76$

(If you got this wrong, the most likely mistake was in entering 1.74×10^{-5} wrongly on your calculator. The most common way would be to enter 1.74, then press EXP, then 5, then +/-, but check your calculator instruction book. You ***mustn't*** enter the number 10 and then press the EXP button.)

e) B is the stronger acid because its K_a value is the greater. The more negative the index (-5 as opposed to -4 in this case), the more zeros you have in the decimal before you get to the other numbers.

f) C is the stronger acid because it has a lower pK_a value.

Important: These questions only cover the material on the Chemguide page, but that isn't enough. You will need to practice doing a whole lot of other related questions - see the last green box on the Chemguide page.