Modify your sketch of liquid water to add 5 hydronium ions (represented as a circled “+”) and 5 hydroxide ions (represented as a circled “‒”). Based on your modified sketch (rather than on what you anticipate to be the correct answer), calculate to one significant figure the pH of the water.

1. –1
2. 2
3. 3
4. 4
5. 5
6. ∞

Liquid water

Modify your sketch of liquid water to add 5 hydronium ions (represented as a circled “+”) and 5 hydroxide ions (represented as a circled “‒”).
Modify your sketch of liquid water to add 5 hydronium ions (represented as a circled “+”) and 5 hydroxide ions (represented as a circled “-”). Based on your modified sketch (rather than on what you anticipate to be the correct answer), calculate to one significant figure the pH of the water.

17% 1. -1  
17% 2. 1  
17% 3. 7  
17% 4. 10  
17% 5. 14  
17% 6. ∞  

Liquid water

Further modify your sketch of liquid water so that it corresponds to pH = 7.

[Quiz] The pH of solution C is approximately ...

17% 1. 1  
17% 2. 7  
17% 3. 10  
17% 4. 14  
17% 5. ∞  
17% 6. Something else

Weak acids and strong acids in aqueous solution
What is an acid in aqueous solution?
An acid makes $[\text{H}_3\text{O}^+] > [\text{OH}^-]$

Is an acid strong or weak?
A $c_a$ M aqueous solution of an acid HA has $\text{pH} = x$ and so $[\text{H}_3\text{O}^+] = 10^{-x}$.
From this, how can we know whether HA is a strong acid or a weak acid?

Key idea:
The closer $[\text{H}_3\text{O}^+]$ is to $c_a$, the stronger the acid.
The larger $K_a = [\text{H}_3\text{O}^+] [\text{A}^-] / [\text{HA}]$, the stronger the acid.

Strong acids react nearly 100%, and so their $K_a >> 1$
So almost all HA converted to $\text{H}_3\text{O}^+$ and $\text{A}^-$
So $[\text{HA}] \approx 0$, $[\text{H}_3\text{O}^+] = c_a$ and therefore $\text{pH} = -\log(c_a)$
Is an acid strong or weak?

A $c_a$ M aqueous solution of an acid HA has pH = $x$ and so $[H_3O^+] = 10^{-x}$.

From this, how can we know whether HA is a strong acid or a weak acid?

$$\text{HA(aq)} + \text{H}_2\text{O(l)} \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{A}^-(aq)$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$c_a = 0.05$ M HA has pH = 1.3

$$= -\log(c_a) = -\log(0.05) = 1.3$$

So HA is strong.

Weak acids react much less than 100%, and so their $K_a \ll 1$

$\text{So hardly any HA converted to H}_3\text{O}^+$ and $\text{A}^-$

So $[\text{HA}] \approx c_a \ [H_3O^+] \ll c_a$ and therefore pH $\gg -\log(c_a)$
Which solution in the diagram contains the most dilute acid?

- 25% A
- 25% B
- 25% C
- 25% D

The reason for your choice in the previous question was that the solution showed the ...

- 14% highest proportion of A⁻
- 14% lowest proportion of A⁻
- 14% highest [H₂O⁺]
- 14% lowest [H₂O⁺]
- 14% highest [HA] + [A⁻]
- 14% lowest [HA] + [A⁻]
- 14% equal [HA] and [A⁻]