

Chemguide – answers

STRONG AND WEAK BASES

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

In a solution of sodium hydroxide, the NaOH is 100% ionised as sodium ions and hydroxide ions. By contrast, in a solution of ammonia, an equilibrium is set up in which most of the ammonia is still present as ammonia, and only a small percentage has reacted to give ammonium ions and hydroxide ions.

2. a) $[\text{OH}^-] = 0.200$

$$K_w = [\text{H}^+][\text{OH}^-] = 1.00 \times 10^{-14}$$

$$[\text{H}^+] \times 0.200 = 1.00 \times 10^{-14}$$

$$[\text{H}^+] = 5.00 \times 10^{-14}$$

$$\text{pH} = -\log_{10}[5.00 \times 10^{-14}]$$

$$\text{pH} = 13.3$$

b) $[\text{OH}^-] = 0.0100$

$$K_w = [\text{H}^+][\text{OH}^-] = 1.00 \times 10^{-14}$$

$$[\text{H}^+] \times 0.0100 = 1.00 \times 10^{-14}$$

$$[\text{H}^+] = 1.00 \times 10^{-12}$$

$$\text{pH} = -\log_{10}[1.00 \times 10^{-12}]$$

$$\text{pH} = 12.0$$

b) $[\text{OH}^-] = 0.0200 \times 2 = 0.0400$ (calcium hydroxide is $\text{Ca}(\text{OH})_2$)

$$K_w = [\text{H}^+][\text{OH}^-] = 1.00 \times 10^{-14}$$

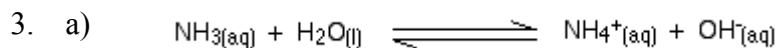
$$[\text{H}^+] \times 0.0400 = 1.00 \times 10^{-14}$$

$$[\text{H}^+] = 2.50 \times 10^{-13}$$

$$\text{pH} = -\log_{10}[2.50 \times 10^{-13}]$$

$$\text{pH} = 12.6$$

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b)
$$K_b = \frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]}$$

c)
$$\text{p}K_b = -\log_{10} K_b$$

d)
$$K_b = 4.37 \times 10^{-4}$$

$$\text{p}K_b = -\log_{10}(4.37 \times 10^{-4})$$

$$\text{p}K_b = 3.36$$

(If you are getting these questions wrong, the most likely mistake is in entering numbers like 4.37×10^{-4} wrongly on your calculator. The most common way would be to enter 4.37, then press EXP, then 4, 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 base because its K_b value is the greater.

f) D is the stronger base because it has a lower $\text{p}K_b$ value.

Important: These questions only cover the material on the Chemguide page, but that isn't enough. Check your syllabus and past papers to see what you need to be able to do, and then practise doing a lot of examples.