Calculating pH and pOH Practice 1

Use mental math shortcuts for calculating pH and pOH to solve the problems below. If you get stuck, try the *Logs and Antilogs Practice 1* worksheet as a handy warmup.

1) What is the pH of 2 $moldm^{-3}$ HCl?

2) What is the pH of 2 $moldm^{-3}$ H_2SO_4?

3) What is the pH of $1x10^{-3}$ $moldm^{-3}$ HNO_3?

4) What is the pH of 2 $moldm^{-3}$ NaOH?

5) What is the pH of 0.25 $moldm^{-3}$ $Ca(OH)_2$?

6) What is the pH of $5x10^{-3}$ $moldm^{-3}$ KOH?

7) What is the pH of a mixture of $50cm^3$ $0.1moldm^{-3}$ HCl and $30cm^3$ of $0.1moldm^{-3}$ NaOH?

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Solutions

Keep in mind:

$14 = pH + pOH$

$pH = -\log [H^+]$

$pOH = -\log [OH^-]$

$-\log (1x10^{-3}) = 3$

$-\log (1x10^{3}) = -3$

$-\log(3x10^{-x}) = x.5$

$-\log(5x10^{-x}) = x.3$

$-\log(8x10^{-x}) = x.1$

1) What is the pH of 2 $moldm^{-3}$ HCl?
   $2 = 2 \times 10^0$
   $pH = -\log[2x10^0]$
   Therefore pH is between -1 and 0.
   2 is between 1 and 3. Therefore pH is -1 plus a number approx. in the range 0.5 to 1. Estimate 0.7 ish. -1 + 0.7 = -0.3
   With a calculator, answer is -0.3.

2) What is the pH of 2 $moldm^{-3}$ H_2SO_4?
   H_2SO_4 donates two H^+ ions, unlike 1 for the other acids featured in this worksheet. Therefore $[H^+] = 2x2moldm^{-3}$
   $pH = -\log (4) = -\log(4 x10^{0)}$
   Again, pH will be between -1 and 0.
   4 is between 3 and 5. pH will be -1 plus a number in the range 0.3 to 0.5.
   Estimate 0.4 ish. -1 + 0.4 = -0.6
   With a calculator, answer is -0.6

3) What is the pH of $1x10^{-3}$ mol dm^{-3} HNO_3?
   $pH = -\log(1x10^{-3}) = 3$

4) What is the pH of 2 mol dm^{-3} NaOH?
   $2 = 2 \times 10^0$
   $pOH = -\log[2x10^0]$
   Therefore pOH is between -1 and 0.
   2 is between 1 and 3. Therefore pOH is -1 plus a number approx. in the range 0.5 to 1. Estimate 0.7. -1 + 0.7 = -0.3
   With a calculator, answer is -0.3.

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pH = 14 – pOH
Therefore 14 – (-0.3) = 14.3

5) What is the pH of 0.25 mol dm^{-3} $Ca(OH)_2$?
Base has two hydroxide ions per molecule, therefore can receive two protons. [OH-] = 2 x 0.25 = 0.5 mol dm^{-3}
pOH = -log (0.5) = -log (5×10^{-1}) = 0.3
pH = 14 – 0.3 = 13.7

6) What is the pH of 5 $x10^{-3}$ mol dm^{-3} KOH?
pOH = -log ($5x10^{-3}$) = 3.3
pH = 14-3.3 = 10.7

7) What is the pH of a mixture of 50cm^3 0.1moldm^{-3} HCl and 30cm^3 of 0.1moldm^{-3} NaOH?
Total volume of the solution is now 50cm^3 + 30cm^3 = 80cm^3
The acid and base are the same concentration. But different volumes.
Therefore 30 cm^3 of NaOH will be neutralised by 30cm^3 (out of 50 cm^3) of HCl, leaving 20 cm^3 of HCl left unreacted.
HCl's original concetration was 0.1moldm^{-3}, but it will now be diluted by 4 because 20 cm^3 is left unreacted of HCl and it is in 80cm^3 total. (20/80 = 4).
HCl's new concentration is 0.1/4 = 0.025 moldm^{-3}
pH = -log (2.5×10^{-2}) ≈ 1.5 (actual answer is 1.6)