gridlocks – can you unlock the grid?

pH and pOH

pH values and pOH values are connected because $K_w = 1 \times 10^{-14} = [H^+][OH^-]$ at room temperature. The relationships between them are summarised in the equations below. But before you dive for your calculator it is worth knowing how the nice round convenient numbers convert so you get a 'feel' for the type of answer you are expecting. Before you answer the gridlocks below fill in the table of pH and pOH values – see how many you can do without using the calculator.

$pH = -\log_{10}[H^+]$ **$[H^+] = 10^{-pH}$** **$pOH = -\log_{10}[OH^-]$** **$pOH + pH = 14 = pK_w$**

$[H^+]$	pH	pOH	$[OH^-]$
1		14	1×10^{-14}
0.1		13	
1×10^{-3}		11	
	5		1×10^{-9}
	7	7	1×10^{-7}
1×10^{-9}	9		
1×10^{-12}		2	0.01
1×10^{-14}	14		1

Gridlock 1

Each row, column and 2 x 2 box contains information about the first four $[H^+]$ listed above. Use your problem solving skills and the answers in the table above to fill in the blank boxes.

$[H^+]$		pH	
1			5
	1×10^{-5}	0	
	11		
		1×10^{-13}	

pOH $[OH^-]$

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Gridlock 2

Each row, column and 2 x 2 box contains the last four $[H^+]$ listed above.

$[H^+]$		pH	
1×10^{-9}			7
			1
2			
pOH		$[OH^-]$	

Gridlock 3

Work out the pH values in this gridlock contains and then solve it.

$[H^+]$		pH	
5×10^{-4}			
		1.3	
		1×10^{-12}	
	1.3		
pOH		$[OH^-]$	

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pH and pOH – answers

pH values and pOH values are connected because $K_w = 1 \times 10^{-14} = [H^+][OH^-]$ at room temperature. The relationships between them are summarised in the equations below. But before you dive for your calculator it is worth knowing how the nice round convenient numbers convert so you get a 'feel' for the type of answer you are expecting. Before you answer the gridlocks below fill in the table of pH and pOH values – see how many you can do without using the calculator.

$pH = -\log_{10}[H^+]$ **$[H^+] = 10^{-pH}$** **$pOH = -\log_{10}[OH^-]$** **$pOH + pH = 14 = pK_w$**

$[H^+]$	pH	pOH	$[OH^-]$
1	0	14	1×10^{-14}
0.1	1	13	1×10^{-13}
1×10^{-3}	3	11	1×10^{-11}
1×10^{-5}	5	9	1×10^{-9}
1×10^{-7}	7	7	1×10^{-7}
1×10^{-9}	9	5	1×10^{-5}
1×10^{-12}	12	2	0.01
1×10^{-14}	14	0	1

Gridlock 1 – answers

Each row, column and 2 x 2 box contains information about the first four $[H^+]$ listed above. Use your problem solving skills and the answers in the table above to fill in the blank boxes.

$[H^+]$		pH	
1	0.1	3	5
1×10^{-3}	1×10^{-5}	0	1
13	11	1×10^{-9}	1×10^{-14}
9	14	1×10^{-13}	1×10^{-11}
pOH		$[OH^-]$	

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Gridlock 2 – answers

Each row, column and 2 x 2 box contains the last four $[H^+]$ listed above.

$[H^+]$		pH	
1×10^{-9}	1×10^{-12}	14	7
1×10^{-14}	1×10^{-7}	9	12
7	5	0.01	1
2	0	1×10^{-7}	1×10^{-5}
pOH		$[OH^-]$	

Gridlock 3 – answers

Work out the pH values in this gridlock contains and then solve it.

$[H^+]$		pH	
5×10^{-4}	0.05	12.7	2
2×10^{-13}	0.01	1.3	3.3
12.7	10.7	1×10^{-12}	0.05
12	1.3	2×10^{-11}	2×10^{-13}
pOH		$[OH^-]$	

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