13. $K_w = [H_3O^+][OH^-]$

$[H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1.0 \times 10^{-14}}{0.000055} = 1.8 \times 10^{-10}$

✓ (2)

14. a) pH = 4.55

$pH + pOH = 14$

$14 - 4.55 = pOH$

$pOH = 9.45$

$[OH^-] = 10^{-pOH}$

$= 10^{-9.45} = 3.5 \times 10^{-10} M$

$[H_3O] = 10^{-pH}$

$= 10^{-4.55} = 2.8 \times 10^{-5} M$

Units ✓ ✓ 2.5

b) $[H_3O^+] = 2.45 \times 10^{-12}$

$K_w = [H_3O^+][OH^-]$

$[OH] = \frac{K_w}{[H_3O^+]} = \frac{1.0 \times 10^{-14}}{2.45 \times 10^{-12}} = 0.0040_8 \rightarrow 0.0041\ M$

2.5

$pOH = -\log(OH)$

$= -\log(0.0040_8)$

$= 2.39$ ✓

$pH = -\log(H_3O)$

$= -\log(2.45 \times 10^{-12})$

$= 11.6$ 5f

15. a) The pH of the water will decrease at a higher temperature because the equilibrium will work to lower the temperature after a temperature rise by absorbing the extra heat in the endothermic process. The forward reaction will be favoured making more H^+ and OH^- ions. With a higher concentration of H^+ the pH will decrease.

(3) ✓

$2H_2O_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$

$\longrightarrow$ products favoured.