Calculating pH After Dilution Answer Key

1. (a) $\text{pH} = -\log[H_3O^+(aq)]$

$\text{pH} = -\log(0.489)$

$\text{pH} = 0.311$

(b) $c_1V_1 = c_2V_2$

$\left(0.489\,\frac{\text{mol}}{\text{L}}\right)(0.0350\,\text{L}) = c_2\,(0.300\,\text{L})$

$c_2 = 0.0571\,\frac{\text{mol}}{\text{L}}$

(c) $\text{pH} = -\log[H_3O^+(aq)]$

$\text{pH} = -\log(0.0571)$

$\text{pH} = 1.243$

(d) The answers do make sense. As the concentration of the acid decreases, pH increases.

2. $c_1V_1 = c_2V_2$

$\left(3.52\times10^{-3}\,\frac{\text{mol}}{\text{L}}\right)(0.020\,\text{L}) = c_2\,(25\,\text{L})$

$c_2 = 2.8\times10^{-6}\,\frac{\text{mol}}{\text{L}}$

$[H_3O^+(aq)] = 2.8\times10^{-6}\,\frac{\text{mol}}{\text{L}}$

$\text{pH} = -\log[H_3O^+(aq)]$

$\text{pH} = -\log\left(2.8\times10^{-6}\,\frac{\text{mol}}{\text{L}}\right)$

$\text{pH} = 5.55$

Calculating pH After Dilution Answer Key (continued)

3. Concentrated solution

$$3.5\,\text{g HBr(aq)} \times \frac{1\,\text{mol}}{80.91\,\text{g}} \times \frac{1}{20.0\,\text{L}} = 0.0022\,\frac{\text{mol}}{\text{L}}\ \text{HBr(aq)}$$

$$c_1V_1 = c_2V_2$$

$$\left(0.0022\,\frac{\text{mol}}{\text{L}}\right)(0.0500\,\text{L}) = c_2\,(100\,\text{L})$$

$$c_2 = 1.1\times10^{-6}\,\frac{\text{mol}}{\text{L}}\ \text{HBr(aq)}$$

New solution

$$1.1\times10^{-6}\,\frac{\text{mol}}{\text{L}}\,\text{HBr(aq)} \times \frac{1\,\text{mol}\ H_3O^+(\text{aq})}{1\,\text{mol HBr(aq)}} = 1.1\times10^{-6}\,\frac{\text{mol}}{\text{L}}\,H_3O^+(\text{aq})$$

$$\text{pH} = -\log[H_3O^+(\text{aq})]$$

$$\text{pH} = -\log\left(1.1\times10^{-6}\,\frac{\text{mol}}{\text{L}}\right)$$

$$\text{pH} = 5.96$$

4. Dilution of the concentrated solution to make a new solution of lower concentration is more precise than measuring out the solute into 100 L of water to make the new solution. The amount of HBr(s) required to make the dilute solution is very small. Any error in weighing or loss of solute during transfer could cause the final concentration of the new solution to be slightly off. In addition, the concentrated stock solution, once made, can be used to make a wide variety of solutions of varying concentration.