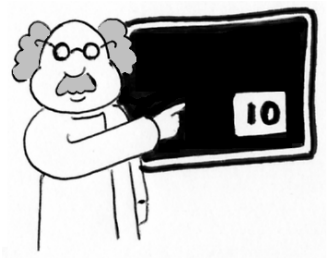


STARTER FOR 10...

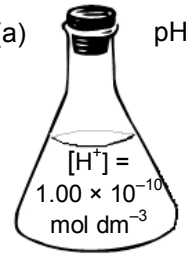
3.1. pH and K_w

1. Complete the table below showing some numbers and their common logarithmic values; (1 mark)

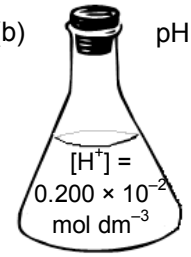
Number (n)	$\log_{10} n$
0.001	.....
0.1	.....
.....	0
.....	3

2. Calculate the pH (to 2 dp) of each of the solutions below: (3 marks)

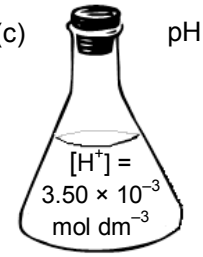
(a) pH = ...



(b) pH = ...



(c) pH = ...



3. As water is always slightly ionised, we can write the following equilibrium for water;

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq) \quad \Delta H = +ive$$

As only a very small amount of the water is ionised, we define a new equilibrium constant for this equilibrium called the **ionic product of water**, K_w;

$$K_w = [H^+(aq)]\,[OH^-(aq)]$$

Like any other equilibrium constant, the value of K_w depends on the temperature of the equilibrium.

(a) Predict what effect increasing the temperature will have **on the pH** of pure water.

.....(1 mark)

(b) Calculate the pH of pure water (to 2 dp) at each of the temperatures below;

(i) 10 °C, $K_w = 0.29 \times 10^{-14}$ mol^2 dm^{-6}.....

(ii) 25 °C, $K_w = 1.01 \times 10^{-14}$ mol^2 dm^{-6}.....

(iii) 40 °C, $K_w = 2.92 \times 10^{-14}$ mol^2 dm^{-6}.....(3 marks)

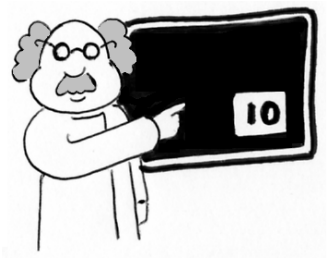
(c) Complete the paragraph below;

As the temperature decreases, water becomes (more acidic / less acidic / remains neutral).

Explain your answer

.....

.....(2 marks)



STARTER FOR 10...

3.2. pH and acids

1. Identify the species formed when the following act as acids;

(a) HCl .....

(b) NH_4^+.....

(c) HCO_3^- ..... (3 marks)

2. Calculate the pH (to 2 dp) of the following acids;

(a) 0.25 mol dm^{-3} HCl.....(1 mark)

(b) 0.004 mol dm^{-3} $NaHSO_4$, K_a of HSO_4^- = 1.00 × 10^{-2} mol dm^{-3}

.....

.....

.....(2 marks)

3. Calculate the concentration of the following acids given their pH.

(a) HCl, pH 0.65 .....(1 mark)

(b) H_2SO_4, pH 2.61 .....(1 mark)

(c) CH_3COOH, pH 3.40, K_a 1.7 × 10^{-5} mol dm^{-3}

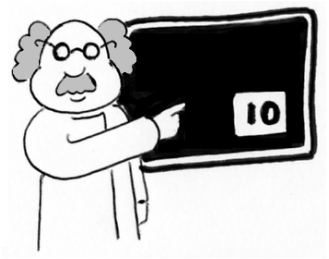
.....

.....

.....

.....

.....(2 marks)



STARTER FOR 10...

3.3. pH and bases

1. Define;

(a) a Brønsted-Lowry acid .....

.....(1 mark)

(b) a Brønsted-Lowry base .....

.....(1 mark)

2. In the following acid-base reactions identify the **reactant species** (ion or molecule) acting as a Brønsted-Lowry base;

(a) $2\ NH_3 + H_2SO_4 \rightarrow (NH_4^+)_2SO_4^{2-}$

(b) $Ca(OH)_2 + H_2CO_3 \rightarrow CaCO_3 + 2\ H_2O$

(c) $Na_2CO_3 + 2\ HCl \rightarrow 2\ NaCl + H_2O + CO_2$ (3 marks)

3. Calculate the pH (to 2 dp) of the following basic solutions (take K_w to be 1.00×10^{-14} mol^2 dm^{-6});

(a) 0.150 mol dm^{-3} NaOH.....

.....(1 mark)

(b) 0.261 mol dm^{-3} $Mg(OH)_2$.....

.....(1 mark)

4. Calculate the concentration of the following basic solutions (take K_w to be 1.00×10^{-14} mol^2 dm^{-6});

(a) KOH, pH 11.00.....

.....(1 mark)

(b) $Ca(OH)_2$, pH 10.45.....

.....(1 mark)

5. Ethylamine is a weak base. Draw a curly arrow on the diagram below to show how the ethylamine acts as a base.