



# STARTER FOR 10!!!

## 3. Acids and bases answers

### 3.1. pH and $K_w$

1.

Number ( $n$ )	$\log_{10} n$
0.001	<u>-3</u>
0.1	<u>-1</u>
<u>1</u>	0
<u>1.000</u>	3

(1 mark for all numbers correct)

2. (a) pH = 10.00

(b) pH = 2.70

(c) pH = 2.46

(3 marks, 1 mark for each correct answer given to 2 dp)

3. (a) Ionisation of water is endothermic ( $\Delta H$  +ive) so increasing the temperature will favour the forward reaction and hence the  $[H^+(aq)]$  will increase. As a result the pH of the water will decrease as the temperature is increased. (1 mark)

(b) (i)  $10^\circ C$ ,  $K_w = 0.29 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ ;  $[H^+(aq)] = 5.39 \times 10^{-8} \text{ mol dm}^{-3}$   $\therefore$  pH = 7.27

(ii)  $25^\circ C$ ,  $K_w = 1.01 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ ;  $[H^+(aq)] = 1.00 \times 10^{-7} \text{ mol dm}^{-3}$   $\therefore$  pH = 7.00

(iii)  $40^\circ C$ ,  $K_w = 2.92 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ ;  $[H^+(aq)] = 1.71 \times 10^{-7} \text{ mol dm}^{-3}$   $\therefore$  pH = 6.77 (3 marks)

(c) As the temperature decreases, water remains neutral (1 mark)

Water is always neutral as  $[H^+(aq)] = [OH^-(aq)]$  and so there is always an equal number of  $H^+$  ions and  $OH^-$  ions. (1 mark)

### 3.2. pH and acids

1. (a)  $HCl \rightarrow H^+ + Cl^-$

(b)  $NH_4^+ \rightleftharpoons H^+ + NH_3$

(c)  $HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$  (3 marks)

2. (a)  $pH = -\log[0.25] = 0.60$  (1 mark)

(b)  $K_a = \frac{[H^+][SO_4^{2-}]}{[HSO_4^-]} = \frac{[H^+]^2}{[HSO_4^-]}$   $\therefore [H^+]^2 = (1.0 \times 10^{-2}) \times 0.004 = 4 \times 10^{-5}$

$$[H^+] = 6.32 \times 10^{-3} \text{ mol dm}^{-3}$$

$$\therefore pH = -\log[6.32 \times 10^{-3}]$$

$$\therefore \text{pH} = \underline{2.20}$$

(1 mark for  $K_a$  expression, 1 mark for pH)

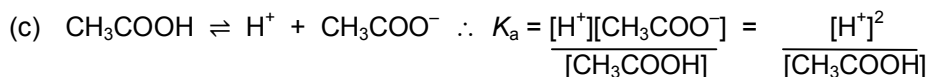
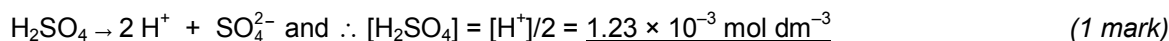
3. (a)  $[H^+] = 10^{-0.65}$   $\therefore [H^+] = 0.22 \text{ mol dm}^{-3}$   $\therefore$   $[HCl] = 0.22 \text{ mol dm}^{-3}$  (1 mark)

(b)  $[H^+] = 10^{-2.61}$   $\therefore [H^+] = 2.45 \times 10^{-3} \text{ mol dm}^{-3}$



# STARTER FOR 10!!!

## 3. Acids and bases answers



$$\text{pH} = -\log[\text{H}^+], \therefore [\text{H}^+] = 10^{-3.40}, \therefore [\text{H}^+] = 3.98 \times 10^{-4} \text{ mol dm}^{-3} \quad (1 \text{ mark})$$

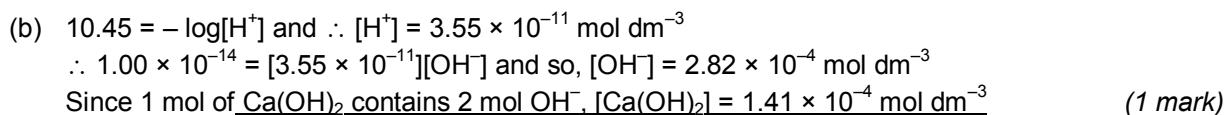
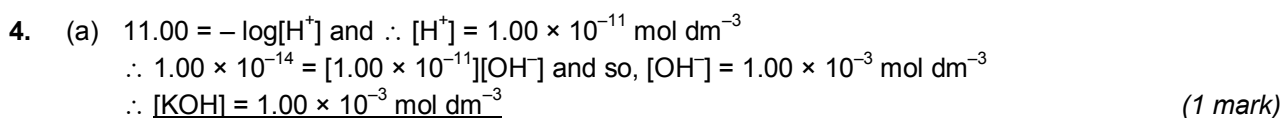
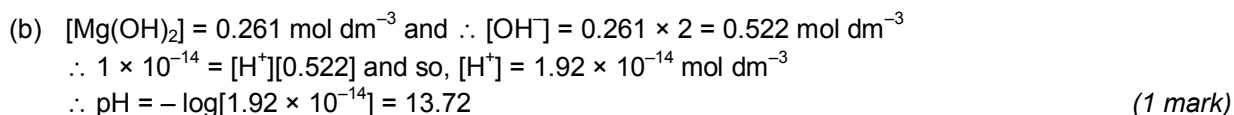
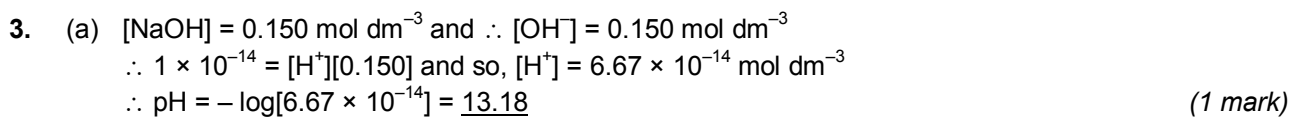
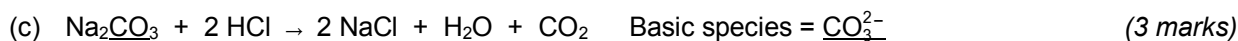
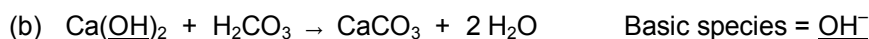
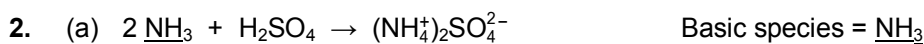
$$\therefore 1.7 \times 10^{-5} = [3.98 \times 10^{-4}]^2 / [\text{CH}_3\text{COOH}]$$

$$\therefore \underline{[\text{CH}_3\text{COOH}] = 9.32 \times 10^{-3} \text{ mol dm}^{-3}} \quad (1 \text{ mark})$$

### 3.3. pH and bases

1. (a) A Brønsted-Lowry acid is a proton donor (1 mark)

(b) A Brønsted-Lowry base is a proton acceptor (1 mark)



5. (1 mark)

