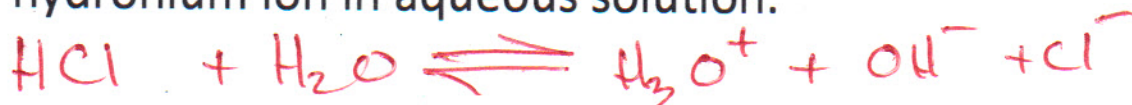
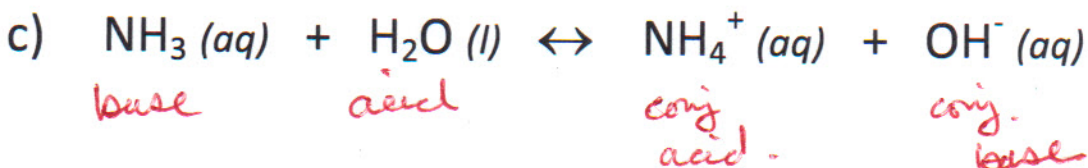
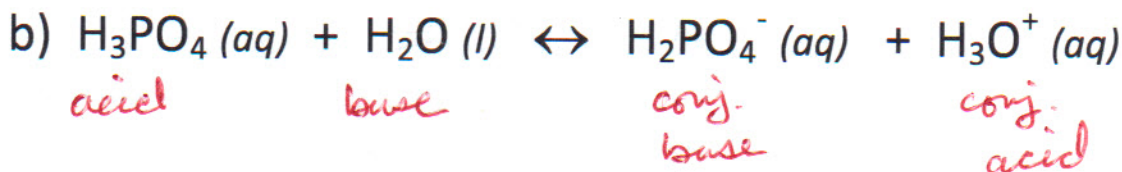
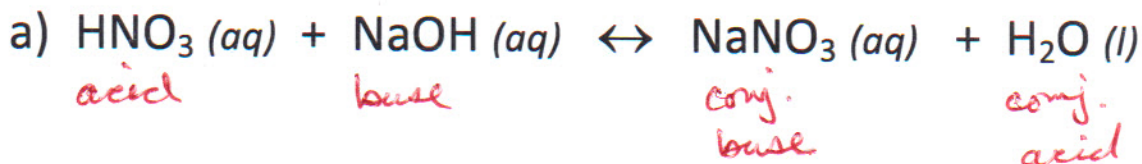


1. Show an equilibrium expression for hydrochloric acid (HCl) and hydronium ion in aqueous solution.



2. Label the acid/base and conjugate acid/base below.



3. Use $K_w = 1.0 \times 10^{-14}$ to determine $[\text{H}^+]$ in water for:

a) $[\text{OH}^-] = 1 \times 10^{-14} \text{ M}$ $[\text{H}^+] = \frac{1.0 \times 10^{-14}}{1 \times 10^{-14}} = 1 \text{ M}$

b) $[\text{OH}^-] = 1 \times 10^{-2} \text{ M}$ $[\text{H}^+] = \frac{1.0 \times 10^{-14}}{1 \times 10^{-2}} = 1 \times 10^{-12} \text{ M}$

c) $[\text{OH}^-] = 5 \times 10^{-6} \text{ M}$ $[\text{H}^+] = \frac{1.0 \times 10^{-14}}{5 \times 10^{-6}} = 2 \times 10^{-9} \text{ M}$

d) $[\text{OH}^-] = 8 \times 10^{-6} \text{ M}$ $[\text{H}^+] = \frac{1.0 \times 10^{-14}}{8 \times 10^{-6}} = 1.25 \times 10^{-9} \text{ M}$

e) $[\text{OH}^-] = 1 \times 10^{-7} \text{ M}$ $[\text{H}^+] = \frac{1.0 \times 10^{-14}}{1 \times 10^{-7}} = 1 \times 10^{-7} \text{ M}$

$[\text{H}^+][\text{OH}^-] = K_w$
 $[\text{H}^+] = \frac{K_w}{[\text{OH}^-]}$

Name: _____

4. Find the pH for:

a) $[H^+] = 1 \times 10^{-1} M$ $pH = 1$

b) $[H^+] = 1 \times 10^{-6} M$ $pH = 6$

c) $[H^+] = 1 \times 10^{-7} M$ $pH = 7$

d) $[H^+] = 1 \times 10^{-8} M$ $pH = 8$

e) $[H^+] = 1 \times 10^{-14} M$ $pH = 14$

f) $[H^+] = 4.5 \times 10^{-9} M$ $pH = -\log(4.5 \times 10^{-9}) = 8.35$

g) $[H^+] = 4.0 \times 10^{-9} M$ $pH = -\log(4.0 \times 10^{-9}) = 8.40$

h) $[H^+] = 3.5 \times 10^{-9} M$ $pH = -\log(3.5 \times 10^{-9}) = 8.46$

need calculator

5. Find the acid concentration $[H^+]$ for:

a) $pH = 1$ $[H^+] = 10^{-1} M = 0.1 M$

b) $pH = 6$ $[H^+] = 10^{-6} M = 1 \times 10^{-6} M$

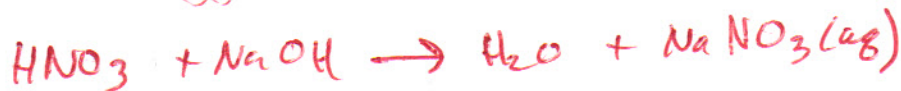
c) $pH = 8.0$ $[H^+] = 10^{-8.0} M \Rightarrow 1.0 \times 10^{-8} M$

b) $pH = 6.63$ $[H^+] = 10^{-6.63} = 2.3 \times 10^{-7} M$

calculator

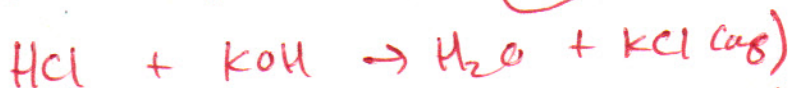
Name: _____

8. A 25.00 mL sample of HNO₃ of unknown concentration is titrated to an endpoint using 18.3 mL of 0.115 M NaOH. Find the acid molarity.



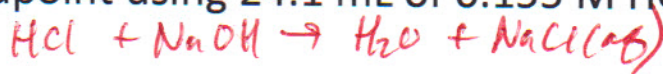
$$M = \frac{\# \text{ mol acid}}{\text{vol acid}} = \frac{0.001}{(0.0183 \text{ L NaOH}) \left(0.115 \frac{\text{mol NaOH}}{\text{L NaOH}} \right) \left(\frac{1 \text{ mol HNO}_3}{1 \text{ mol NaOH}} \right)}{0.02500 \text{ L}} = 0.0842 \text{ M}$$

9. A 25.00 mL sample of HCl of unknown concentration is titrated to an endpoint using 11.7 mL of 0.088 M KOH. Find the acid molarity.



$$M = \frac{\# \text{ mol acid}}{\text{vol. acid}} = \frac{(0.0117 \text{ L KOH}) \left(0.088 \frac{\text{mol KOH}}{\text{L KOH}} \right) \left(\frac{1 \text{ mol HCl}}{1 \text{ mol KOH}} \right)}{0.02500 \text{ L}} = 0.041 \text{ M}$$

10. A 5.00 mL sample of NaOH of unknown concentration is titrated to an endpoint using 24.1 mL of 0.155 M HCl. Find the base molarity.



$$M = \frac{\# \text{ mol base}}{\text{vol base}} = \frac{(0.0241 \text{ L HCl}) \left(0.155 \frac{\text{mol HCl}}{\text{L HCl}} \right) \left(\frac{1 \text{ mol NaOH}}{1 \text{ mol HCl}} \right)}{0.0050 \text{ L}} = 0.747 \text{ M}$$

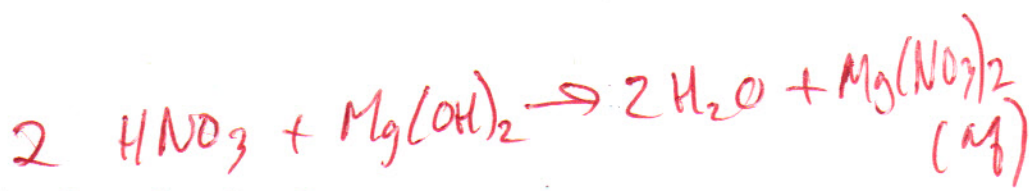
Name: _____

diprotic acid

11. A 25.00 mL sample of H_2SO_4 of unknown concentration is titrated to an endpoint using 11.7 mL of 0.088 M NaOH. Find the acid molarity.

$$H_2SO_4 + \underline{\underline{2}} NaOH \rightarrow 2H_2O + Na_2SO_4(aq)$$
$$M = \frac{\# \text{ mol acid}}{\text{vol acid}} = \frac{(0.0117 \text{ L NaOH}) \left(0.088 \frac{\text{mol NaOH}}{\text{L NaOH}} \right) \left(\frac{1 \text{ mol } H_2SO_4}{2 \text{ mol NaOH}} \right)}{0.02500 \text{ L}}$$
$$= 0.021 \text{ M}$$

12. A 5.00 mL sample of $Mg(OH)_2$ of unknown concentration is titrated to an endpoint using 28.8 mL of 0.0055 M HNO_3 . Find the ~~acid~~^{base} molarity.



$$M = \frac{\# \text{ mol acid}}{\text{vol acid}} = \frac{\cancel{0.0288 \text{ L}}}{(0.0288 \text{ L } HNO_3) \left(0.0055 \frac{\text{mol } HNO_3}{\text{L } HNO_3} \right) \left(\frac{1 \text{ mol } Mg(OH)_2}{2 \text{ mol } HNO_3} \right)}$$
$$= \frac{\cancel{0.0288 \text{ L}}}{0.00500 \text{ L}}$$
$$= 0.016 \text{ M}$$