1. Calculate the pH of the following solutions:

# a) 0.025 M LiOH (aq)

LiOH is a strong base, from Group I  $\therefore$  [OH<sup>1-</sup>] = [LiOH]

$$pOH = - \log [OH^{1-}]$$

$$= - \log [0.025]$$

$$= 1.60206$$

$$pH = 14 - pOH$$

$$= 14 - 1.60206$$

$$= 12.40$$

### b) 3.00 HI (aq)

HI is a strong acid  $\therefore$  [H<sub>3</sub>O<sup>1+</sup>] = [HI]

pH = 
$$-\log [H_3O^{1+}]$$
  
=  $-\log [3.00]$   
=  $-0.477$   
3 sig digs in the concentration gives  
3 decimals in the pH

## c) 0.060 M Ba(OH)<sub>2</sub> (aq)

Ba(OH)<sub>2</sub> is a strong base, from Group II.:  $[OH^{1-}] = 2 \times [Ba(OH)_2] = 0.12 \text{ M}$ 

$$pOH = - \log [OH^{1-}]$$
  
= - log [0.12]  
= 0.9208  
$$pH = 14 - pOH$$
  
= 14 - 0.9208  
= 13.08

### d) 5.00 M H<sub>2</sub>SO<sub>4</sub> (aq)

$$H_{2}SO_{4} \text{ is a strong acid } \therefore [H_{3}O^{1+}] = [H_{2}SO_{4}]$$

$$H_{2}SO_{4} \text{ ioniz}$$

$$H_{2}SO_$$

remember, only the first proton (H+) in H<sub>2</sub>SO<sub>4</sub> ionizes significantly unless the acid is very dilute

e) 25 mL of 15.0 M HNO<sub>3</sub> stock solution diluted to 1.0 L of solution

Calculate the concentration of the diluted acid using the dilution equation:  $C_1V_1 = C_2V_2$ \* both volumes must be in the same units, convert 25 mL to L by dividing by 1000

$$C_1V_1 = C_2V_2$$

$$0.025 L \times 15.0 M = C_2 \times 1.0 L$$

$$C_2 = \underbrace{0.025 L \times 15.0 M}_{1.0 L}$$

$$= 0.375 M \qquad HNO_3 \text{ is a strong acid, therefore:} [H_3O_+] = [HNO_3] = C_2$$

$$pH = -\log [H_3O^{1+}]$$

$$= -\log [0.375]$$

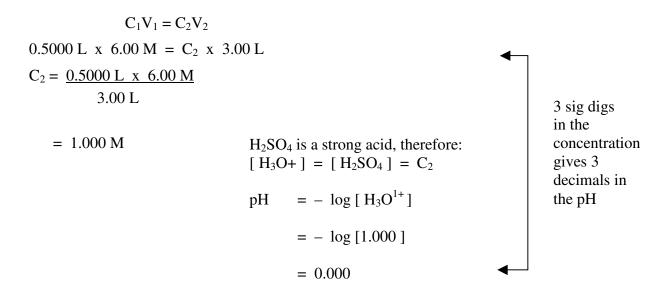
$$= 0.43$$

## f) 3.66 g of NaOH dissolved in 400.0 mL of solution

$3.66 \text{ g NaOH x } \frac{1 \text{ mol}}{40.00 \text{ g}} = 0.09150 \text{ mol}$	NaOH is a strong base, from Group I $\therefore$ [ OH <sup>1-</sup> ] = [ NaOH ]
$c = \underline{n}$	$pOH = - \log [OH^{1-}]$
V	$= -\log [0.22875]$
= <u>0.0915 mol</u>	= 0.64064
0.4000 L	pH = 14 – pOH
= 0.22875 M	= 14 - 0.64064
	= 13.359 (3 decimal places)

#### g) 500.0 mL of 6.00 H<sub>2</sub>SO<sub>4</sub> solution diluted to 3.00 L of solution

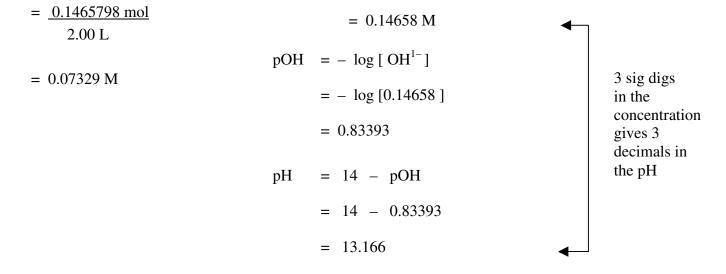
Calculate the concentration of the diluted acid using the dilution equation:  $C_1V_1 = C_2V_2$ \* both volumes must be in the same units, convert 500.0 mL to L by dividing by 1000



#### h) 8.55 g of solid Mg(OH)<sub>2</sub> dissolved in 2.00 L of solution

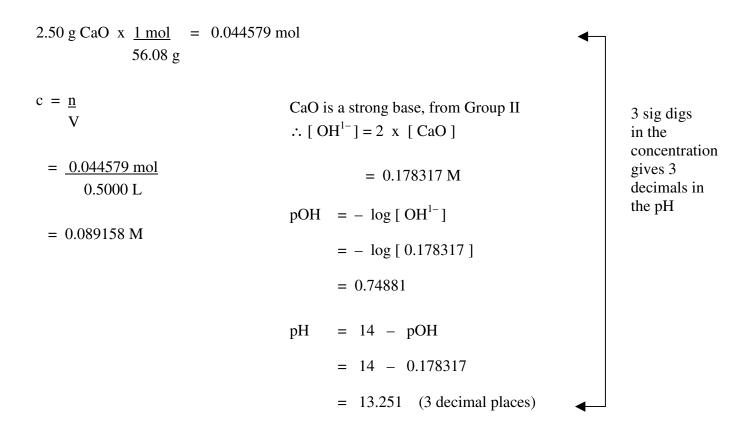
8.55 g Mg(OH)<sub>2</sub> x  $\underline{1 \text{ mol}}$  = 0.1465798 mol 58.33 g

 $c = \underline{n}$ V  $Mg(OH)_2 \text{ is a strong base, from Group II}$   $\therefore [OH^{1-}] = 2 \times [Mg(OH)_2]$ 



#### i) 2.50 g of CaO (s) dissolved in 500.0 mL of solution

CaO reacts with water to produce  $OH^{1-}$ : CaO (s) + H<sub>2</sub>O (l)  $\rightarrow$  Ca<sup>2+</sup> (aq) + 2 OH<sup>1-</sup> (aq)



2. In all of these examples, the pH of the acids is very low and the pH of the bases is very high. Suggest a reason why.

All of these substances are strong acids and bases and their concentrations are fairly high (above 0.10 M). They completely ionize/dissociate in water to produce high concentrations of  $H_3O+$  and OH- ions, so the acids have very low pH and the bases have very high pH.

If, however, the concentration of HCl (a strong acid) was only 0.0000100 M, the pH would be only 4.000, showing that the pH of a solution depends on both the strength and concentration of the acid.

 $[H_{3}O+] = [HC1]$   $pH = -\log [H_{3}O^{1+}]$   $= -\log [0.0000100]$  = 4.000