

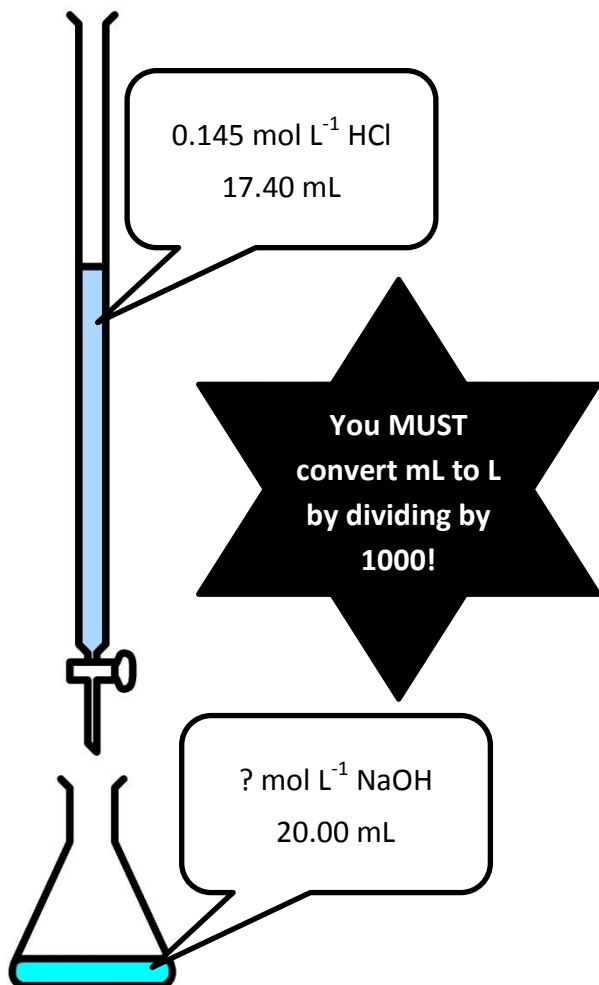
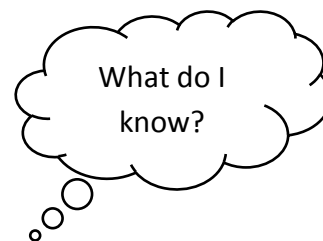
AS 91161

QUANTITATIVE ANALYSIS HELP SHEET

Titration calculations made simple

**1 : 1 mole ratio:** e.g.  $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

Aim: To find the concentration of the NaOH.



	HCl	NaOH
ratio	1	1
n		
c	0.145 mol L <sup>-1</sup>	
V	0.01740 L	0.0200 L

	HCl	NaOH
ratio	1	1
n	❶ 0.002523 mol	❷ 0.002523 mol
c	0.145 mol L <sup>-1</sup>	❸ 0.126 mol L <sup>-1</sup>
V	0.01740 L	0.0200 L

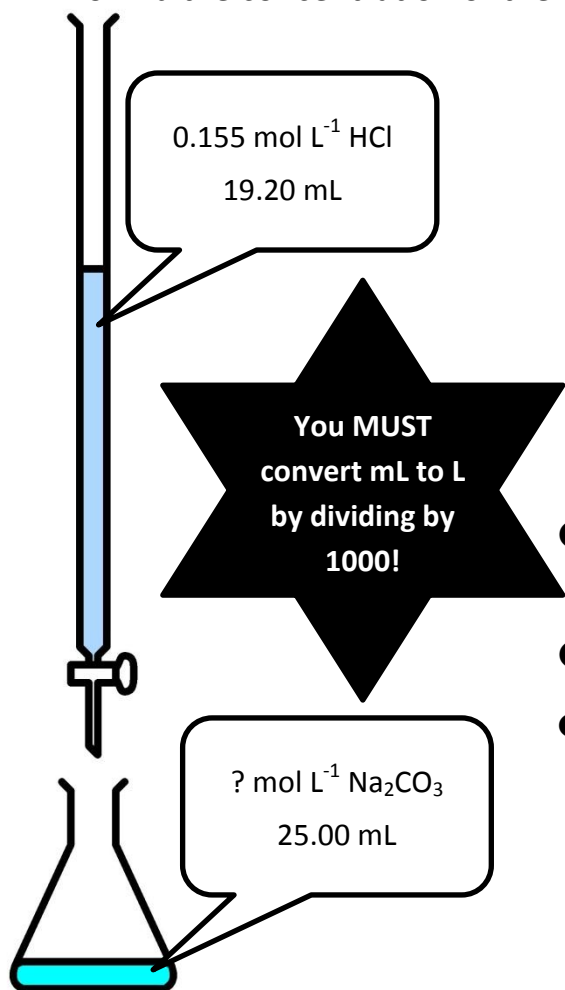
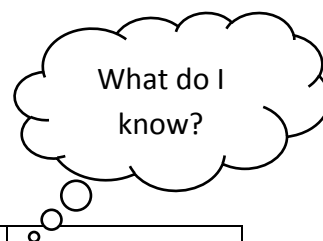
It's as easy as n....n....c..... ☺

- ❶  $n(\text{HCl}) \quad n = cV \quad n(\text{HCl}) = 0.145 \times 0.01740 = 0.002523 \text{ mol}$  (keep all the figures in your calculator!) You can write this as  $2.523 \times 10^{-3} \text{ mol}$ , if you prefer.
- ❷  $n(\text{NaOH})$  HCl and NaOH react in a 1 : 1 ratio, so  $n(\text{NaOH}) = 0.002523 \text{ mol}$  (AND YES, still keep all the figures in your calculator!)
- ❸  $c(\text{NaOH}) \quad c = n/V$  so  $c(\text{NaOH}) = 0.002523 / 0.0200 = 0.12615 \text{ mol L}^{-1}$ . You know you are right if n was already (still) in your calculator.

Now write your final answer to 3 s.f.  $c(\text{NaOH}) = 0.126 \text{ mol L}^{-1}$ .

**2 : 1 mole ratio:** e.g.  $2\text{HCl} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

Aim: To find the concentration of the  $\text{Na}_2\text{CO}_3$ .



	HCl	$\text{Na}_2\text{CO}_3$
ratio	2	1
n	①	②
c	$0.155 \text{ mol L}^{-1}$	③
V	0.01920 L	0.0250 L

- ①  $n(\text{HCl}) = cV$      $n(\text{HCl}) = 0.155 \times 0.01920 = 0.002976 \text{ mol}$
- ②  $n(\text{Na}_2\text{CO}_3) = 0.002976 / 2^* = 0.001488 \text{ mol}$
- ③  $c(\text{Na}_2\text{CO}_3) = 0.001488 / 0.0250 = 0.05952 \text{ mol L}^{-1}$   
 $c(\text{Na}_2\text{CO}_3) = 0.0595 \text{ mol L}^{-1}$  (3 s.f.)

We find the “2 thing” (① HCl) and want the “1 thing” (②  $\text{Na}_2\text{CO}_3$ ), the smaller “thing”, so we DIVIDE by 2. 😊

**1 : 2 mole ratio:** e.g.  $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

This isn't difficult either. Remember n,n,c 😊

	$\text{H}_2\text{SO}_4$	NaOH
ratio	1	2
n	0.00625 mol	0.0125 mol
c	$0.125 \text{ mol L}^{-1}$	$0.553 \text{ mol L}^{-1}$
V	0.0250 L	0.02260 L

25.0 mL of  $0.125 \text{ mol L}^{-1} \text{H}_2\text{SO}_4$  was neutralised by 22.60 mL of NaOH solution. What was the concentration of the NaOH solution?

Start with the substance you know 2 things about – the c and V – and find its n; find n of the other using the mol ratio, Then n/V will give you the c that you are after. Don't forget to give final answer to 3 s.f. And make sure numbers have units... mL or L, mol and  $\text{mol L}^{-1}$ .