**Concentration expressed as percentage composition**

Concentration expressed as a percentage composition is referring to the percentage of solute in a particular solution. This may be on a mass or volume basis and leads to notations such as 10% (m/m), 5% (m/v) or 15% (v/v).

percentage composition by mass (%m/m) = mass solute in g x 100

mass solution in g

percentage composition by volume (% v/v) = volume of solute in mL x 100

volume of solution in mL

percentage composition by mass/volume (%m/v) = mass of solute in g x 100

volume of solution in mL

**Problems**

1. Calculate the moles of sodium ions present in 650 mL of a 2.00% (g/mL) sodium carbonate solution. (0.245 mol Na+)
2. The concentration of calcium in milk is 0.114% (m/m) and the recommended daily amount of calcium consumed by a teenager is 1300 mg. How many glasses of milk would need to be consumed to achieve this recommended daily amount? Assume the volume of the glass is 250 mL and that 100 mL of milk has a mass of 103 g. (4.42)
3. Concentrated hydrochloric acid has a density of 1.16 g mL-1 and contains 32.0% by mass of hydrogen chloride. What volumes of this concentrated acid and of water would need to be mixed together to prepare 500 mL of a 2.00 molL-1 HCl solution? (vacid=98.2 mL; vwater = 401.8 mL)
4. A sample of household cloudy ammonia is found to contain 5.00% ammonia by mass. Its density is 0.977 g mL-1 . What is the concentration in molL-1 of this ammonia solution? (2.87M)
5. A common method for commercially peeling potatoes is to soak them for 1-5 minutes in a 10 - 20 % (m/m) solution of NaOH at 60 - 88oC and to spray off the peel once the potatoes are removed from the solution. As an economy measure a manufacturer titrates the used NaOH with a standardised solution of H2SO4 at the end of each day to determine whether the solution is still capable of peeling potatoes.
   1. If at the end of the day the chemist finds that it takes 64.0mL of a 0.200M solution of H2SO4 to titrate a 10.0 mL sample of NaOH solution what was the concentration of the NaOH in mol L-1? (2.56M)
   2. To be able to peel potatoes the NaOH solution must be at least 10% by mass. Is the solution able to be recycled? The density of the solution was found to be 1.10 g mL-1

(the 2.56M solution not suitable as it needs to be 2.75M)

**ANSWERS**

1. %(m/v) = 2 =



2 = x 100



⇒massNa2CO3 = = 13 g



nNa2CO3 =



= = 0.127 mol



nNa+ = 2 x 0.127 = 0.245 mol

2. First find mg of Ca in a glass of milk

Mass glass milk = 2.5 x 103 = 257.5 g

%(m/m) = 0.114 = x 100



0.114 = x 100



⇒ mass Ca = 0.294 g

= 294 mg

Need 1300 mg

Number of glasses milk needed = = 4.42



3. nHCl = cv = (2) (0.5) = 1 mole

massHCl needed = 1.008 + 35.45 = 36.458 g

%(m/m) = 32 = x 100



32 = x 100



⇒ mass solution = x 100 = 113.9 g



density = 1.16 =



1.16 =



⇒ volume acid = = 98.2 mL



Volume water = 500 – 98.2 = 401.8 mL

4. %(m/m) = 5 = x 100 (assume volume of 1000 mL)



⇒ mass NH3 = = 48.85 g



nNH3 = = = 2.87 mol



c = = = 2.87 mol L-1



5. a) H2SO4 + 2NaOH → 2H2O + Na2SO4

v = 64 mL v = 10 mL

c = 0.2 M

n = cv nNaOH = x nH2SO4



= (0.2) (0.064) = x 0.0128 = 0.0256 mol



c = = = 2.56 M



b) NaOH needs to by 10% (m/m)

10 = x 100



10 = x 100 (assume 1 litre)



⇒ massNaOH = = 110 g



nNaOH = = = 2.75 mol



c = = = 2.75 M is what the molarity of the NaOH solution needs to be



2.56 < 2.75 so the solution cannot be used to peel potatoes