Rafa Muñoa
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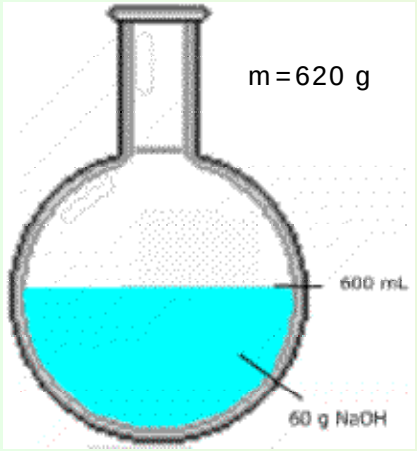
Zarautz

Solutions: worked example



The mass of a solution of NaOH is 620 g and the volume is 600 mL. The amount of solute added is 60 g. Calculate:

a)the amount of moles of the solute
b)the density of the solution
c)the concentration (in g/L, mol/L or M and %)

(Atomic weights: Na=23; O=16; H=1)

mass of the solute ... m=		g
# of moles of the solute ... n=		mol
volume of the solution ... V=		L

M (molar mass)

concentration of the solution		g/L
		M
		%

M

d (density)

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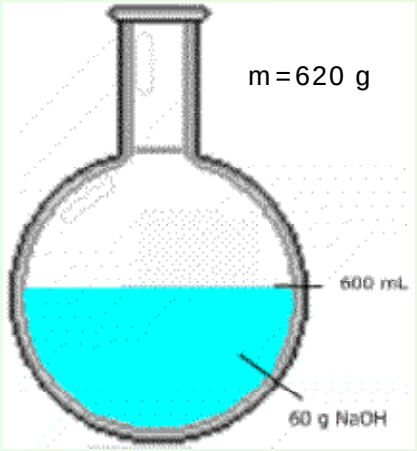

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(Atomic weights: Na=23; O=16; H=1)

mass of the solute ... m=	**60**	g
# of moles of the solute ... n=	**1.5**	mol
volume of the solution ... V=	**0.6**	L

M

concentration of the solution		g/L
		M
		%

M

d

a) the amount of moles of the solute

Using the value of the molar mass, we can know the number of moles

$$M = 23 + 16 + 1 = 40 \ g/mol$$

$$n = 60\ g \frac{1\ mol}{40\ g} = 1.5\ mol\ NaOH$$

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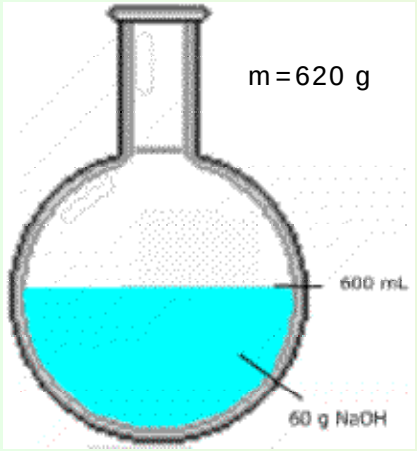

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# of moles of the solute ... n=	**1.5**	mol
volume of the solution ... V=	**0.6**	L

M

concentration of the solution		g/L
		M
		%

M

d

b) the density of the solution

Both the density and the concentration of a solution can have the same units –g/L-, but there is a very important difference between them: **in the case of the concentration the mass is that of the solute and in the case of density the mass is the total mass of the solution (solute + solvent)**

$$d = \frac{620 \text{ g solution}}{0.6 \text{ L solution}} = 1033 \frac{\text{g solution}}{\text{L solution}}$$

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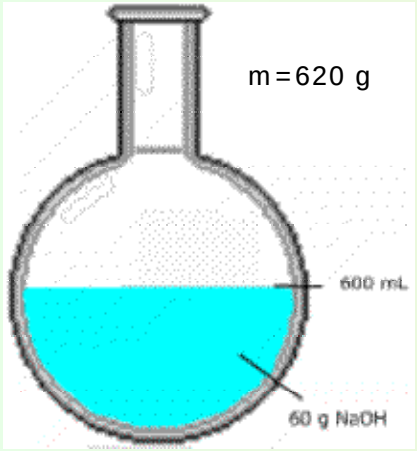

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c) the concentration (in g/L, mol/L or M and %)

(Atomic weights: Na=23; O=16; H=1)

mass of the solute ... m=	**60**	**g**
# of moles of the solute ... n=	**1.5**	mol
volume of the solution ... V=	**0.6**	**L**

M

concentration of the solution	**100**	**g/L**
		M
		%

M

d

c) concentration in g/L

Given the mass of the solute and the volume of the solution we can get the concentration in g/L units.

$$c\ (g/L) = \frac{60\ g\ NaOH}{0.6\ L\ solution} = 100\ \frac{g\ NaOH}{L\ solution}$$

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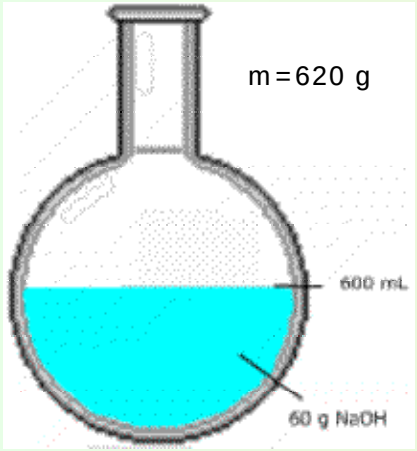

The mass of a solution of NaOH is 620 g and the volume is 600 mL. The amount of solute added is 60 g. Calculate:

a) the amount of moles of the solute
b) the density of the solution
c) the concentration (in g/L, mol/L or M and %)

(Atomic weights: Na=23; O=16; H=1)

mass of the solute ... m=	**60**	g
# of moles of the solute ... n=	**1.5**	**mol**
volume of the solution ... V=	**0.6**	**L**

M

concentration of the solution	**100**	g/L
	2.5	**M**
		%

M

d

c) concentration in mol/L or M

Given the number of moles of solute and the volume of the solution we can get the concentration in mol/L.

$$c\ (\text{mol/L}) = \frac{1.5\ \text{mol NaOH}}{0.6\ \text{L solution}} = 2.5\ \frac{\text{mol NaOH}}{\text{L solution}} = 2.5\ \text{M}$$

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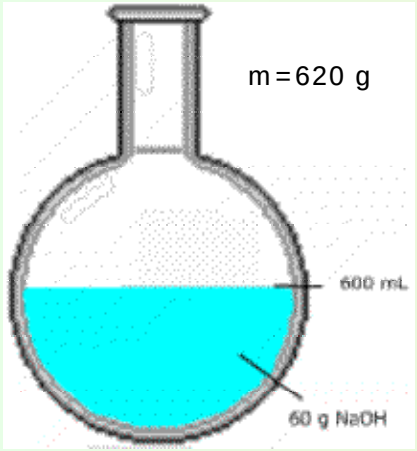
Solutions: worked example



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a) the amount of moles of the solute
b) the density of the solution
c) the concentration (in g/L, mol/L or M and %)

(Atomic weights: Na=23; O=16; H=1)

mass of the solute ... m=	**60**	g
# of moles of the solute ... n=	**1.5**	mol
volume of the solution ... V=	**0.6**	L

M

concentration of the solution	**100**	**g/L**
	2.5	M
	9.7	**%**

M

d

c) concentration in %

To determine the concentration in % from the concentration in g/L we need to know the density, as shown below.

$$c\,(\%) = \frac{100\text{ g NaOH}}{\text{L solution}} \cdot \frac{1\text{ L solution}}{1033\text{ g solution}} \cdot \frac{100\text{ g solution}}{100\text{ g solution}} = 9.7\ \frac{\text{g NaOH}}{100\text{ g solution}} = 9.7\ \%$$

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Solutions: worked example

The mass of a solution of NaCl is 840 g and the volume is 810 mL. The amount of solute added is 50 g. Calculate:

a)the amount of moles of the solute
b)the density of the solution
c)the concentration (in g/L, mol/L or M and %)

(Atomic weights: Na=23; Cl=35.5)

SOLUTIONS:

a) n = 0.855 mol of NaCl
b) d = 1037 g/L
c) c=61.73 g/L; c=1.055 M; c=5.95 %

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Solutions: worked example

The volume of a solution of HNO_3 is 800 mL and the density is 1040 g/L. If the concentration is 20%, calculate:

a)the mass of the solute
b)the # of moles of the solution
c)the concentration (in g/L and mol/L or M)

(Atomic weights: H=1; N=14; O=16)

SOLUTIONS:

a) m = 166.4 g of HNO_3
b) n = 2.64 mol of HNO_3
c) c=208 g/L; c=3.3 M