Question 1.1
What is the molarity when 0.75 mol CaSO\(_4\) (calcium sulphate) is dissolved in 2.50 L of solution?

molarity = moles of solute / volume of solution

molarity = \([\text{CaSO}_4]\) = \(c = \frac{n}{V} = \frac{0.75 \text{ mol}}{2.50 \text{ L}} = 0.30 \text{ mol/L} = 0.30 \text{ M}\)

Question 1.2
Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride in sea water?

molarity = moles of solute / volume of solution

molar mass of NaCl = 23.0 + 35.5 = 58.5 g/mol

moles of NaCl = mass/molar mass = \(\frac{28.0}{58.5} = 0.479 \text{ mol}\)

molarity = \([\text{NaCl}] = c = \frac{n}{V} = \frac{0.479 \text{ mol}}{1 \text{ L}} = 0.479 \text{ mol/L} = 0.479 \text{ M}\)

Question 1.3
5.95g of potassium bromide (KBr) was dissolved in water, and make a 400 mL solution.

(a) Calculate its molarity. (b) What is the concentration in grams per L?

(a) moles = mass / molar mass, (KBr = 39.1 + 79.9 = 119 g/mol)

mol KBr = \(\frac{5.95}{119} = 0.0500 \text{ mol}\)

400 mL = 400/1000 = 0.400 L

molarity = moles of solute / volume of solution

molarity of KBr solution = \(\frac{0.0500}{0.400} = 0.125 \text{ mol/L}\)

(b) concentration = mass / volume, volume = 400 / 1000 = 0.400 L

concentration = \(\frac{5.95}{0.400} = 14.9 \text{ g/L}\)

Question 1.4

(a) How many moles of H\(_2\)SO\(_4\) are there in 250 mL of a 0.800 mol/L sulfuric acid solution?

(b) What mass of acid is in this solution?

(a) molarity = moles of solute / volume of solution, rearranging equation for the sulfuric acid

mol H\(_2\)SO\(_4\) = molarity H\(_2\)SO\(_4\) x volume of H\(_2\)SO\(_4\) in L

mol H\(_2\)SO\(_4\) = \(0.800 \times \frac{250}{1000} = 0.200 \text{ mol}\)
mass = moles x molar mass

molar mass of $\text{H}_2\text{SO}_4 = 1.0 \times 2 + 32 + (4 \times 16) = 98$

$0.200 \text{ mol H}_2\text{SO}_4 \times 98 = 20 \text{ g of H}_2\text{SO}_4$

**Question 1.5**

What mass of sodium hydroxide (NaOH) is needed to make up 500 mL of a 0.500 mol/L solution?

1 mole of NaOH = 23.0 + 16.0 + 1.0 = 40 g

c = n / V

$n = c \times V$

$500 \text{ mL} = 500/1000 = 0.50 \text{ L}$

$\text{mol NaOH needed} = n = 0.500 \times 0.500 = 0.250 \text{ mol}$

$\text{mass} = \text{mol} \times \text{molar mass} = 0.250 \times 40 = 10 \text{ g NaOH required}$

**Question 1.6**

*What is the concentration of sodium chloride (NaCl) in g/L and g/mL in a 1.50 M solution?*

molar mass NaCl = 23.0 + 35.5 = 58.5 g/mol

mass = mol x molar mass, for 1 L solution, $n = c \times V = 1.50 \times 1 = 1.50 \text{ mol}$

mass = 1.50 mol x 58.5 g/mol = 87.8 g,

concentration = 87.8 g / 1L = 87.8 g/L

concentration = 87.8 g / 1000 mL = 0.0878 g/mL

**Question 1.7**

A solution of calcium sulphate (CaSO$_4$) contained 0.500 g dissolved in 2.00 L of water.

Calculate the concentration in (a) g/L, (b) g/mL and (c) mol/L.

(a) concentration = 0.500/2.00 = 0.250 g/L, then since 1L = 1000 mL

(b) concentration = 0.250/1000 = 0.00025 g/mL (or from 0.500/2000 = 0.00025)

(c) molar mass of CaSO$_4$ = 40.1 + 32.1 + (16.0 x 4) = 136

$n = \text{mass/molar mass} = 0.500 / 136 = 0.00368 \text{ mol}$

$[\text{CaSO}_4] = 0.00368 / 2 = 0.00184 \text{ mol/L} = 0.00184$