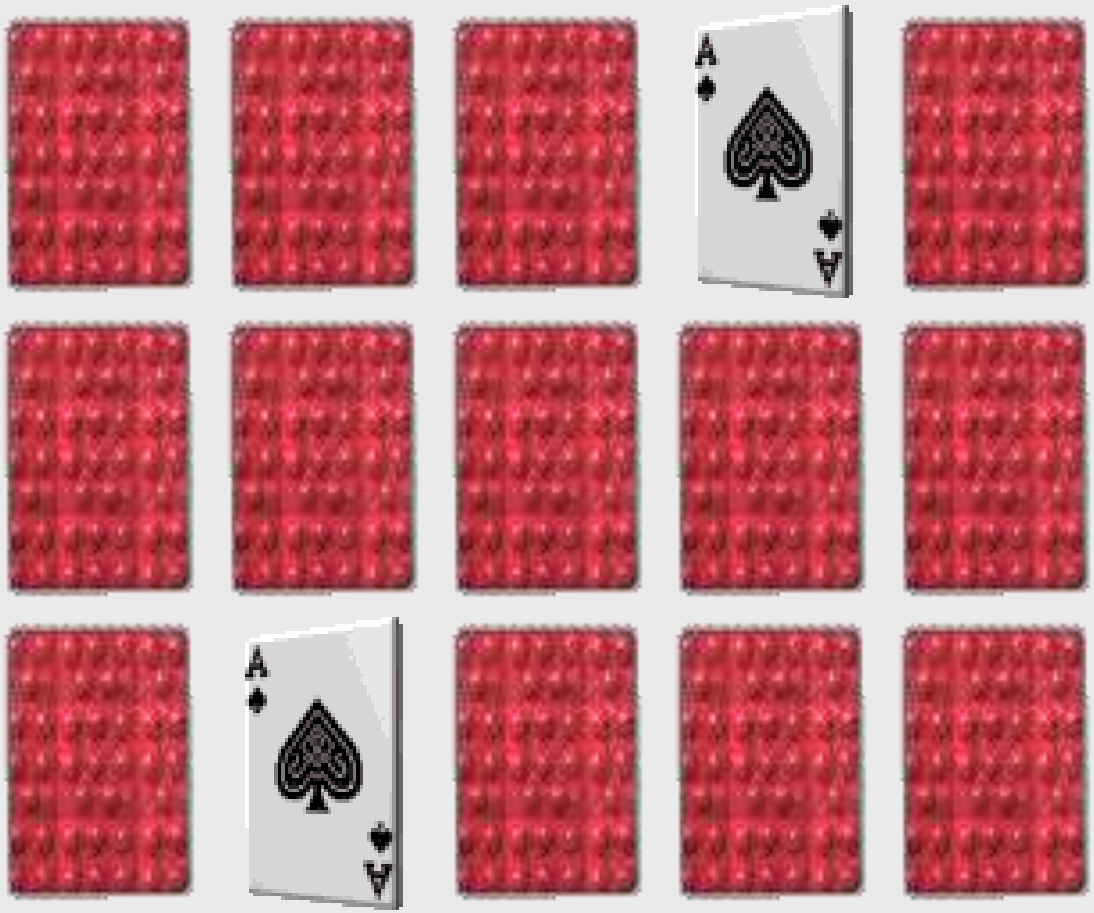
Concentration



Solution Concentration

Read 281 – 283. Try questions 1 – 8 (show work)

Concentration = $\frac{\text{quantity of solute}}{\text{quantity of } \textbf{solution} \text{ (not solvent)}}$

There are 3 basic ways to express concentration:
1) percentages, 2) very low concentrations, and 3) molar concentrations

1) % concentration can be in V/V, W/W, or W/V

- Like most %s, V/V and W/W need to have the same units on top and bottom.
- W/V is sort of in the same units; V is mostly water and water's density is 1 g/mL or 1 kg/L

3 g H_2O_2/100 mL solution $\approx$ 3 g H_2O_2/100 g solution

Solution Concentration

2) Expressing concentrations in parts per million (ppm) requires the unit on top to be 1,000,000 times smaller than the unit on the bottom

   E.g. 1 mg/kg or μg/g

- Multiples of 1000 are expressed in this order

  μ_, m_, _, k_ ("_" is the base unit) (pg.631)

- Notice that any units expressed as a volume must be referring to a water solution (1L = 1kg)
- For parts per billion (ppb), the top unit would have to be 1,000,000,000 times smaller

3) Molar concentration is the most commonly used in chemistry. Ensure that units are mol/L.

1. Percentage concentration (V/V, W/V, W/W), very low concentration, molar concentration
2. % V/V = 4.1 L / 55 L = 7.5% V/V
3. % W/V = 16 g / 50 mL = 32% W/V
4. % W/W = 1.7 g / 35.0 g = 4.9% W/W
5. 8 ppm = 8 _ / 1 L, the units should be 1 million times smaller than 1L (or 1kg): 8ppm = 8 mg/L so the mass in 1 L is 8 mg.
6. 3.2 mg/0.59 kg = 5.$\underline{4}$24 mg/kg = 5.4 ppm
7. a) ppb is 1000 times smaller than ppm

   b) 1 g/10^9 mL, 1 mg/1000 L, 1 μg/L,

   1 mg/kL, 1 mg/Mg, 1 μg/kg
8. 0.11 mol / 0.060 L = 1.8 mol/L

More practice

1. What is the % W/W of copper in an alloy when 10 g of Cu is mixed with 250 g of Zn?

   10 g / 260 g = 3.8 % W/W

2. What is approximate % V/V if 30 mL of pure ethanol is added to 250 mL of water?

   30 mL / 280 mL = 11% V/V (in reality may be off)

3. What is the % W/W if 8.0 g copper is added to enough zinc to produce 100 g of an alloy?)

   8.0 g / 100 g = 8% W/W

Answers

11. 500 mL x 70 mL/100 mL = 350 mL
12. 250 mL x 1000 = 250 L

    250 L x 3 kg/100 L = 7.5 kg
13. 1.5 ppm = 1.5 mg/L

    0.250 L x 1.5 mg/L = 0.38 mg
14. 75 L x 0.055 mol/L = 4.1 mol
15. 0.050 L x 5.0 mol/L = 0.25 mol
16. 0.500 mol x 1 L/1.24 mol = 0.403 L or 403 mL
17. 0.14 mol x 1 L/2.6 mol = 0.0538 L = 54 mL