Exercises

1. A sample contains 45 ng/mL of testosterone. How many grams of testosterone are found in 1.5 L of this sample? (10^9 ng = 1 g)

$$\frac{1.5\text{ L soln}}{1\text{ L}} \left| \frac{10^3\text{ mL}}{\text{mL soln}} \right| \frac{45\text{ ng testos.}}{10^9\text{ ng}} \left| \frac{1\text{ g}}{} \right| = 6.75\times10^{-5}\text{ g}$$

$\Downarrow$ 2 sf

6.8×10^{-5} g testost.

2. Potassium bitartrate, an ionic compound preset in wine sediment, can be used as a laxative. What is the %(w/v) of 80. mL of solution that contains 0.25 g of potassium bitartrate?

$$\frac{0.25\text{ g KBt}}{80\text{ mL}} \times 100 = 0.31250\%\text{(w/v)}$$

$\Downarrow$ 1 sf

0.3% (w/v)

3. How many grams of insulin are present in 25 mL of a 0.45 %(m/v) solution?

0.45 g insulin = 100 mL soln

$$\frac{25\text{ mL soln}}{100\text{ mL soln}} \left| \frac{0.45\text{ g insulin}}{} \right| = 0.1125\text{ g insulin}$$

$\Downarrow$ 2 sf

0.11 g insulin

4. Veterinarians can use sodium iodide to treat animals with ringworm. What is the Molarity of a 95. mL aqueous solution that contains 40. g sodium iodide?

$$\frac{40.0\text{ g NaI}}{95.0\text{ mL}} \left| \frac{1\text{ mol NaI}}{149.89\text{ g}} \right| \frac{10^3\text{ mL}}{1\text{ L}} = 2.8\text{ M NaI}$$

5. Blood plasma typically contains 3.0 mEq/L of Mg^{2+}, calculate how many milligrams of Mg^{2+} are in 250 mL of blood plasma.

$$\frac{250\text{ mL blood}}{10^3\text{ mL}} \left| \frac{1\text{ L}}{1\text{ L blood}} \right| \frac{3.0\text{ mEq } Mg^{2+}}{2\text{ mEq } Mg^{2+}} \left| \frac{24.31\text{ mg } Mg^{2+}}{} \right| = 18.23\text{ mg}$$

$\Downarrow$

18 mg Mg^{2+}

1 mmol Mg^{2+} = 2 mEq Mg^{2+} = 24.31 mg Mg^{2+}

31. Red blood cells have an osmotic pressure equal to 0.30 M total solute concentration.

a) What is the concentration in Molarity of an isotonic saline solution (NaCl)?

$$\frac{0.30 \text{ mole total ions}}{1 \text{ L}} \left| \frac{1 \text{ mole NaCl}}{2 \text{ mole ions}} \right. = 0.15 \text{ M NaCl}$$

b) What is the total solute concentration in %(m/V) for an isotonic saline solution?

$\leftarrow \frac{g}{mL} \times 100$

$$\frac{.15 \text{ mol NaCl}}{1 \text{ L soln}} \left| \frac{58.44 \text{ g NaCl}}{1 \text{ mol}} \right| \frac{1 \text{ L soln}}{10^3 \text{ mL soln}} \times 100 = 0.8766 \text{ (m/V)}$$

note 0.9% (m/V) for 1sf

c) Is a 0.9%(w/v) $CaCl_2$ solution isotonic to red blood cells? Explain your reasoning.

No, 1) molar masses are different

$CaCl_2$ 110.98 g/mol NaCl 58.44 g/mol

2) ion ratios are different

$CaCl_2 \rightarrow Ca^{2+} + 2Cl^{\ominus}$ 3 ions

$NaCl \rightarrow Na^{+} + Cl^{\ominus}$ 2 ions

d) In a real-life emergency, we run out of 0.9% (w/v) saline solution. There is KCl and distilled water available. Would it be acceptable to make a 0.9% (w/v) solution of KCl to use for the intravenous infusion? Explain.

No, b/c NaCl & KCl have different molar masses.

0.9 g NaCl ≠ 0.9 g KCl when we compare the # of ions

32. How would we prepare 1.0 L of an isotonic solution using the KCl and distilled water?

* .30 M total solute

$$\frac{1 \text{ L soln}}{} \left| \frac{0.15 \text{ M KCl}}{1 \text{ L soln}} \right| \frac{74.55 \text{ g KCl}}{1 \text{ mol KCl}} = 11.18 \text{ g}$$

$\Downarrow$ 2sf

11 g KCl

1 mole KCl $\rightarrow$ 1 K^{+} + 1 $Cl^{\ominus}$

2 moles solutes