Name: _____

Science and Technology 404

Concentration in ppm

The concentration of a solution is defined as the amount of solute in a given amount of solution. It can be expressed as g/L, % or ppm (parts per million).

When the amount of solute is very small, we use ppm to express concentration. It is often used to express concentrations of substances in the atmosphere, in water and in the soil.

Formula for aqueous solutions	Formula for non-aqueous solutions
1 ppm = 1 g of solute per 1 000 000 ml of solution	1 ppm = 1 g of solute per 1 000 000 g or 1 ppm = 1 ml of solute per 1 000 000 ml

Converting units: 1 g = 1000 mg 1 kg = 1000 g 1 L = 1000 ml

Questions:

Problems involving aqueous solutions:

1. The water in a lake is contaminated. A technician takes 100 ml of the lake water and determines that the sample contains 5 mg of contaminant. Calculate the concentration of the contaminant in the water in ppm.

2. Two samples of water have been mixed up. One contains pool water, the other, tap water. When the water is tested, Bottle A is found to contain 0.03 mg of chlorine in 75 ml of solution. Bottle B is found to contain 0.0001 g of chlorine in 100 ml of solution. Which is the sample of pool water? The acceptable level of chlorine in drinking water is 0.5 ppm.

3. Water that has more than 50 ppm of minerals in it is considered hard water. Are the following samples hard water or soft water?

   a) 40 mg in 1000 ml

   b) 0.06 g in 1 L

   c) 2.5 mg in 200 ml

   d) 0.015 g in 500 ml

   e) 25 mg in 250 ml

4. Phosphates can lead to increased plant growth and large quantities of phosphates will lead plants to grow out of control. Phosphate levels should not be higher than 0.03 ppm. A water sample from a pond was found to contain 0.0002 mg in 10ml of water. Do you expect to see increased plant growth (algae) in that pond?

5. Nitrates are the main components of fertilizer and their run-off can enter our streams and contaminate our drinking water. High nitrate levels can seriously harm young children.

   Water levels with greater than 40 ppm is deemed unsafe for human consumption. A 50 ml water sample was taken from a stream located near a golf club and tested. It was found to contain 0.003 g of phosphate. Is the water potable?

6. The label on a 355 ml coke can reads that there is there is 141 ppm of sodium in it.
   A) How many milligrams of sodium are in the can of coke?

   B) What is the concentration of sodium in %?

   C) What is the concentration of sodium in g/L?

7. The label on a bottle of water states that the water contains 28 ppm of magnesium.
   a) What is the concentration in g/L?

   b) What is the concentration in %?

8. A residential pool contains 100 000 L of water. It requires a concentration of 3 ppm of chlorine. How much solute (chlorine compound) in grams is needed in the pool?

Problems involving non-aqueous solutions:

9. The acceptable exposure level of mercury (Hg) is 2 ppm. A 30 g sample taken from a waste dump has 0.10 mg of Hg in it. Is this level acceptable?

10. Good quality soil contains at least 500 ppm of zinc (Zn). A 0.05 kg soil sample taken from an industrial section of town was found to contain 0.02 g of zinc. Is this good quality soil?

11. Concentrations of cadmium (Cd) in a soil sample was eight times higher than that prescribed by the authorities. A 1 kg sample of soil was found to contain 0.04 g of cadmium. What is the acceptable level of cadmium?

12. You are told that the acceptable level of a particular contaminant is 20 ppm. Which of the following samples would be considered acceptable?

    a) 0.04 g/L

    b) 0.001 %

1. The water in a lake is contaminated. A technician takes 100 ml of the lake water and determines that the sample contains 5 mg of contaminant. Calculate the concentration of the contaminant in the water in ppm.

5 mg = 0.005 g

$\frac{0.005g}{100\ ml} = \frac{x}{1\ 000\ 000\ ml}$

= 50 ppm

2. Two samples of water have been mixed up. One contains pool water, the other, tap water. When the water is tested, Bottle A is found to contain 0.03 mg of chlorine in 75 ml of solution. Bottle B is found to contain 0.0001 g of chlorine in 100 ml of solution. Which is the sample of pool water? The acceptable level of chlorine in drinking water is 0.5 ppm.

0.03 mg = 0.00003 g

Bottle A $\frac{0.00003\ mg}{75\ ml} = \frac{x}{1\ 000\ 000\ ml}$

= 0.4 ppm

Bottle B $\frac{0.0001\ g}{100\ ml} = \frac{x}{1\ 000\ 000 ml}$

= 1 ppm

3. Water that has more than 50 ppm of minerals in it is considered hard water. Are the following samples hard water or soft water?

a) 40 mg in 1000 ml

40 mg = $\frac{0.04\ g}{1000\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 40 ppm

SOFT

b) 0.06 g in 1 L

$= \frac{0.06\ g}{1000\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 60 ppm

HARD

c) 2.5 mg in 200 ml

2.5 mg = $\frac{0.0025\ g}{200\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 12.5 ppm

SOFT

d) 0.015 g in 500 ml

$= \frac{0.015\ g}{500\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 30 ppm SOFT

e) 25 mg in 250 ml

25 mg = $\frac{0.025\ g}{250\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 100 ppm HARD

4. Phosphates can lead to increased plant growth and large quantities of phosphates will lead plants to grow out of control. Phosphate levels should not be higher than 0.03 ppm. A water sample from a pond was found to contain 0.0002 mg in 10ml of water. Do you expect to see increased plant growth (algae) in that pond?

0.0002 mg = 0.0000002 g $\frac{0.0000002\ g}{10\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 0.02 ppm

NO ALGAE

5. Nitrates are the main components of fertilizer and their run-off can enter our streams and contaminate our drinking water. High nitrate levels can seriously harm young children.

   Water levels with greater than 40 ppm is deemed unsafe for human consumption. A 50 ml water sample was taken from a stream located near a golf club and tested. It was found to contain 0.003 g of phosphate. Is the water potable?

   $\frac{0.003\ g}{50\ ml} = \frac{x}{1\ 000\ 000\ ml}$ = 60 ppm NOT POTABLE

6. The label on a 355 ml coke can reads that there is there is 141 ppm of sodium in it.
   A) How many milligrams of sodium are is in the can of coke?

   $\frac{x}{355\ ml} = \frac{141\ g}{1\ 000\ 000\ ml}$ = 0.05 g = 50 mg of sodium

   B) What is the concentration of sodium in %?

   $\frac{141\ g}{1\ 000\ 000\ ml} = \frac{x}{100\ ml}$ = 0.014 %

   C) What is the concentration of sodium in g/L?

   $\frac{141\ g}{1\ 000\ 000\ ml} = \frac{x}{1000\ ml}$ = 0.141 g/L

7. The label on a bottle of water states that the water contains 28 ppm of magnesium.
   a) What is the concentration in g/L?

   $\frac{X}{1000\ ml} = \frac{28\ g}{1\ 000\ 000\ ml}$ = 0.028 g/L

   b) What is the concentration in %?

   $\frac{X}{100\ ml} = \frac{28\ g}{1\ 000\ 000\ ml}$ = 0.0028 %

8. A residential pool contains 100 000 L of water. It requires a concentration of 3 ppm of chlorine. How much solute (chlorine compound) in grams is needed in the pool?

   100 000 L = 100 000 000 ml $\frac{x}{100\ 000\ 000\ ml} = \frac{3\ g}{1\ 000\ 000\ ml}$

   = 300 g

Problems involving non-aqueous solutions:

9. The acceptable exposure level of mercury (Hg) is 2 ppm. A 30 g sample taken from a waste dump has 0.10 mg of Hg in it. Is this level acceptable?

30 g = 30 000 mg
You can also change both to g

$$\frac{0.1\text{ mg}}{30\,000\text{ mg}} = \frac{x}{1\,000\,000\text{ mg}} = 3.33\text{ ppm}$$

(too high)

10. Good quality soil contains at least 500 ppm of zinc (Zn). A 0.05 kg soil sample taken from an industrial section of town was found to contain 0.02 g of zinc. Is this good quality soil?

0.05 kg = 50 g

$$\frac{0.02\text{ g}}{50\text{ g}} = \frac{x}{1\,000\,000\text{ g}} = 400\text{ ppm (too low, not good qual)}$$

11. Concentrations of cadmium (Cd) in a soil sample was eight times higher than that prescribed by the authorities. A 1 kg sample of soil was found to contain 0.04 g of cadmium. What is the acceptable level of cadmium?

1 kg = 1000 g

$$\frac{0.04\text{ g}}{1000\text{ g}} = \frac{x}{1\,000\,000\text{ g}} = 40\text{ ppm}$$

Since it is 8 times higher, the acceptable level is 40 ppm ÷ 8 = 5 ppm

12. You are told that the acceptable level of a particular contaminant is 20 ppm. Which of the following samples would be considered acceptable?

a) 0.04 g/L

$$\frac{0.04\text{ g}}{1000\text{ ml}} = \frac{x}{1\,000\,000\text{ ml}} = 40\text{ ppm}$$

Not acceptable

b) 0.001 %

$$\frac{0.001\text{ g}}{100\text{ ml}} = \frac{x}{1\,000\,000\text{ ml}} = 10\text{ ppm}$$

Acceptable