Mixing problem #1

A tank contains 20 kg of salt dissolved in 5000 litres of water.
A brine solution with 0.03 kg of salt per litre enters the tank at a rate of 25 litres per minute.
The solution is kept well mixed and it drains out of the tank at the same rate.

How much salt will remain in the tank after 30 minutes?

Mixing problem #2

A pond contains 10 Megalitre of clean water.
A nearby factory dumps in the pond water contaminated with 20 grams per Megalitre of plutonium at a rate of 5 Megalitres per year.
The pond has an emissary creek such that the (well mixed) water exits the pond at that same rate.

Find the equation representing the amount of plutonium in the pond at time t.

Mixing problem #3

250 grams of sugar are dissolved in a tank containing 500 litres of water.
Clean water enters the tank at a rate of 5 litres per minute. The solution in the tank is kept well mixed and it drains from the tank at the same rate.

How much sugar is left after t minutes?
How much sugar is left after 5 hours?

Mixing problem #4

A tank contains 1000 litres of brine with salt concentration equal to 1 kg every 100 litres.
Another brine solution flows into the tank at a constant rate of 20 litres per second.
The solution inside the tank is kept well stirred and it exits the tank at a rate of 10 litres per second.

If the incoming solution has 200 kg of salt per 100 litres, determines the amount of salt within the tank at time t.

Population problem #1

The rate of increase of the population P of a village is proportional to the population size.
In 2004 the population was 2500 people and in 2006 it was 3000.

In what year will the population reach 4320?

Population problem #2

The rate of increase of the population P of a town is proportional to the time t (the number of years after 1980) and inversely proportional to the population size P.
In 1980 the population was 10,000 people and in 1990 it was 20,000 people.

In what year will the population be 52,000?

Heating/Cooling problem #1

Suppose you have just poured a cup of coffee with temperature 95˚C in a room where the temperature is a stable 20˚C. After waiting 1 minute, the temperature of the coffee has come down to 80˚C.

Studies suggest that the best temperature to enjoy coffee is at 65˚C. How much we need to wait to finally drink our cup of coffee?

Heating/Cooling problem #2

A glass of room-temperature water is carried out on a balcony from an apartment where the temperature is 22°C. After 1 minute the water has temperature 26°C and after two minutes it has temperature 28°C.

What is the outdoor temperature?

Heating/Cooling problem #3

An object with temperature 74˚F is placed outside, where the temperature is -20˚F. At 11:05 the temperature of the object is 60˚F and at 11:07 its temperature is 50˚F.

At what time was the object placed outside?