

## Analysis

### Math Problem #1 Solution

$x(t) = 10 \cdot x(t-1) + x(t-1)$  The population at discrete time  $t$  assumes that each member of the previous generation had ten children and that no member of the previous generation dies.

$x(t) = 11 \cdot x(t-1)$  Just a bit of simplification

**Standard Form**  $x(t) = a \cdot x(t-1) + b$

$a := 11$     $b := 0$     $x_0 := 1$    Only one tribble at the start

$x(t) := a^t \cdot \left( x_0 - \frac{b}{1-a} \right) + \frac{b}{1-a} \rightarrow 11^t$  Standard solution for a first-order difference eqn.

In a 72 hour period, there will be 6 generations of tribbles. We can compute the total number of tribbles by substituting in  $t = 6$ .

$x(6) = 1771561$  This is the answer that Spock obtained.

## Math Problem #2 Solution

tribbles := 1

Problem #2 is different than Problem #1 because there is not sufficient information to ensure a unique solution. I am going to make some assumptions.

- Total number of tribbles to be cleaned up is given by the solution to Problem #1.
- The tribbles are all dead from eating the poisoned grain.
- Cyrano Jones is going to work every weekday for 8 hours per day.
- He takes two weeks off for vacation every year.
- I know that Spock says that Cyrano will take 17.9 years to cleanup all the tribbles.
- I am going to estimate the number of tribbles per hour that Cyrano must cleanup every hour.

$N := 1771561 \cdot \text{tribbles}$  Number of dead tribbles.

$T := 17.9 \cdot \text{yr}$  Spock's cleanup time estimate in calendar time.

$T_W := T \cdot \frac{1\text{yr} - 14\text{day}}{\text{yr}} \cdot \frac{8\text{hr}}{\text{day}}$  Work time

Let  $r$  be the rate of tribble cleanup.

$$r \cdot T_W = N$$

$$r := \frac{N}{T_W} = 35.22138 \cdot \frac{\text{tribbles}}{\text{hr}}$$