• This allows us to form the equation

$$20 \text{ (time till maximum reached)} \times 2^{n} \text{ (amount of bacteria)} = \text{Maximum } x \text{ molecules produced by a generation}$$

• Using this we can find the final amount of x-molecules before take off.

$$20 \times 2^{27} = 2.815 \times 10^{15}$$

to d.p.f

This means:

$$\frac{2.815 \times 10^{15}}{x} = 10^{11}$$

$$x = 28150$$

where x is volume of vax in ml in order to acquire wanted concentration

Therefore Kololph's vax must have a volume equal to or less than 28150 ml for it to glow.

Assuming this is the case Kololph's nose will glow in time for Santa!

a very shiny rose?

- To find the number of bacteria in each generation:

  > 2^n, where n equals the number of divisions

- Since there is a division every 30 minutes

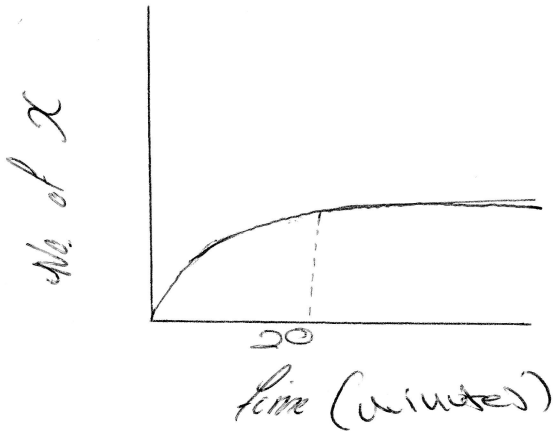
  $22 \times 2 = 48$ divisions in total

  (22 hours till take off; half an hour)

However,

The 48th generation won't have time to produce 3C molecules making the 47th the last generation able to produce the take-off.

- Since each X-molecule has a lifespan of 20 minutes, the maximum amount produced by a single bacterium in each generation is 20.



After 20 minutes they are produced at the rate they are destroyed.

Reaching their maximum amount at 20 minutes since the division.