a) Mathematical equations.

- Definition of variables and parameters.
  - → $N(t)$ = Population of bacteria at time t
  - → r = intrinsic growth rate.
  - → K = Carrying capacity of environment (population)
  - → t = time
  - → N_0 = initial population size.

- Mathematical equations

The logistic growth equation models population growth with a limiting factor

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$$

- Derivation from first principles.

Start from idea that bacterial population change is proportional to existing population

$$\frac{dN}{dt} = rN$$

Exponential growth model. To account for limited resources, introduce a growth limiting factor based on current population.

$$\text{Net growth rate} = rN\left(1 - \frac{N}{K}\right)$$

Thus,

$$\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$$

- Assumptions made.
  - → Homogenous population, that is, no age or size structure
  - → Constant environmental conditions
  - → Growth rate r and carrying capacity K are constants.

in either margin