

1. A population of protozoa develops with a constant relative growth rate of 0.7944 per member per day. On day zero the population consists of two members. Find the population size after six days. **235 members**
2. A common inhabitant of human intestines is the bacterium *Escherichia coli*. A cell of this bacterium in a nutrient-broth medium divides into two cells every 20 minutes. The initial population of a culture is 60 cells.
- Find the relative growth rate. **$k = \ln 8$ or 207.9 %**
 - Find an expression for the number of cells after t hours. **$P(t) = 60e^{(\ln 8)t}$ or $P(t) = 60e^{(2.079)t}$**
 - Find the number of cells after 8 hours. **1,006,632,960**
 - Find the rate of growth after 8 hours. **2.093 billion cells/hr**
 - When will the population reach 20,000 cells? **2.79 h**
3. A bacteria culture starts with 500 bacteria and grows at a rate proportional to its size. After 3 hours there are 8000 bacteria.
- Find an expression for the number of bacteria after t hours. **$P(t) = 500e^{(\ln 16)(t/3)}$ or $P(t) = 500(16)^{t/3}$**
 - Find the number of bacteria after 4 hours. **20,158**
 - Find the rate of growth after 4 hours. **18,631 cells/hr**
 - When will the population reach 30,000? **4.4 h**
4. A bacteria culture grows with constant relative growth rate. After 2 hours there are 600 bacteria and after 8 hours the count is 75,000.
- Find the initial population. **120**
 - Find an expression for the population after t hours. **$P(t) = 120(5)^{(t/2)}$**
 - Find the number of cells after 5 hours. **6708 bacteria**
 - Find the rate of growth after 5 hours. **5398 bacteria/hr**
 - When will the population reach 200,000? **9.2 h**

1. (a) A direction field for the differential equation $y' = y(y - 2)(y - 4)$ is shown. Sketch the graphs of the solutions that satisfy the given initial conditions.
- $y(0) = -0.3$
 - $y(0) = 1$
 - $y(0) = 3$
 - $y(0) = 4.3$
- (b) If the initial condition is $y(0) = c$, for what values of c is $\lim_{t \rightarrow \infty} y(t)$ finite? What are the equilibrium solutions?

