In Section 3.8, we learned the following mathematical models.

- If population $P(t)$ grows exponentially as a function of time t, then

$$P(t) = P_0 e^{kt}, \tag{1}$$

  where P_0 is the population at time 0 and $k > 0$ is a positive constant.

- If the mass $m(t)$ of a radioactive substances decays exponentially as a function of time t, then

$$m(t) = m_0 e^{kt}, \tag{2}$$

  where m_0 is the mass at time 0 and $k < 0$ is a **negative** constant.

- If $T(t)$ is the temperature at time t of an object in a room at surrounding temperature T_s, and $y(t) = T(t) - T_s$, then

$$y(t) = y(0)e^{kt}, \tag{3}$$

  where $y(0) = T(0) - T_s$ and $k < 0$ is a **negative** constant.

- If you invest A_0 in an account yielding interest rate r, compounded n times per year, then t years later, your balance will be

$$A(t) = A_0 \left(1 + \frac{r}{n}\right)^{nt}. \tag{4}$$

  As $n \to \infty$, we get continuously compounded interest:

$$A(t) = A_0 e^{rt}. \tag{5}$$

1. The half-life of fictionium-17 is 70 years. A team of researchers finds a sample of fictionium-17 that has decayed to 6% of its original mass. How long has the sample been decaying?

   Do **NOT** try to solve the problem at first. Instead:

   (a) Identify which of equations (1)–(5) apply to this problem.

   (b) Translate the key parts of the question, word by word, into mathematical statements and questions.

2. If you invest \$17 million in an account that yields 6% interest compounded monthly, how long will it take your investment to reach \$70 million? What is the equivalent annual interest rate (APR)?

   Do **NOT** try to solve the problem at first. Instead:

   (a) Identify which of equations (1)–(5) apply to this problem.

   (b) Translate the key parts of the question, word by word, into mathematical statements and questions.

3. An object with temperature 87°F is placed a room at temperature 70°F, and after one hour, its temperature is 76°F. Find an expression for the temperature of the object at any time t.

   Do **NOT** try to solve the problem at first. Instead:

   (a) Identify which of equations (1)–(5) apply to this problem.

   (b) Translate the key parts of the question, word by word, into mathematical statements and questions.

4. At the beginning of an experiement, a sample contains 17,000 bacteria, and 6 hours later, it contains 70,000 bacteria. How many bacteria will there be after 17 hours?

   Do **NOT** try to solve the problem at first. Instead:

   (a) Identify which of equations (1)–(5) apply to this problem.

   (b) Translate the key parts of the question, word by word, into mathematical statements and questions.