# 11 – Creating and analyzing exponential models

**1.** A person wants to invest money now to help pay for their child to go to college in 11 years. If the person can invest their money at a 4% interest rate, compounded continuously, how much do they need to invest now to ensure they have $10,000 when their child goes to college in 11 years?

**2.** A certain bacteria culture begins with 300 cells and grows by 12% each hour. Write a model for the number of bacteria after $t$ hours, and use it to determine when the culture will reach 2000 cells.

**3.** Given an initial quantity of a radioactive substance, the amount of the substance, measured in the unit becquerel (Bq), remaining after $t$ years can be modeled by the equation $Q(t) = Q_0 e^{kt}$.

**(a)** What does $Q_0$ represent? Why?

**(b)** Suppose that 3000 Bq of a radioactive substance is measured in a sample initially, and 2600 Bq is present 10 years later. Write a specific model of the form $Q(t) = Q_0 e^{kt}$ for the amount of the substance remaining after $t$ years by determine the values of $Q_0$ and $k$.

**(c)** After how many years will only 50 Bq of the substance remain?

**(d)** By what percentage does the amount the substance change each year?

**4.** Carbon-14 is a radioactive isotope. Given an initial quantity of Carbon-14, the amount of Carbon-14 remaining after $t$ years can be modeled by $Q(t) = Q_0 e^{kt}$.

**(a)** Use that Carbon-14 has a half life of 5730 years, to determine the value of $k$ in the above model.

**(b)** If there is an initial amount of 1500 Bq in an object, how much Carbon-14 will remain after 10,000 years?