Exponential Modelling

There are two key features of exponential functions which make them suitable for **population growth**:

1. **a^x gets a times bigger each time x increases by 1. (Because $a^{x+1} = a \times a^x$)**
   With population growth, we typically have a fixed percentage increase each year. So suppose the growth was 10% a year, and we used the equivalent decimal multiplier, 1.1, as a. Then 1.1^t, where t is the number of years, would get 1.1 times bigger each year.
2. **The rate of increase is proportional to the size of the population at a given moment.**
   This makes sense: The 10% increase of a population will be twice as large if the population itself is twice as large.

Example

[Textbook] The density of a pesticide in a given section of field, P mg/m^2, can be modelled by the equation $P = 160e^{-0.006t}$ where t is the time in days since the pesticide was first applied.

a. Use this model to estimate the density of pesticide after 15 days.

b. Interpret the meaning of the value 160 in this model.

c. Show that $\frac{dP}{dt} = kP$, where k is a constant, and state the value of k.

d. Interpret the significance of the sign of your answer in part (c).

e. Sketch the graph of P against t.

Exercise 14C Pg 318-319