## Pre-Calculus
## Exponential Modeling Practice

Write an exponential model of the form $y = a \cdot e^{bt}$ that represents the problem situation. Use it to answer the questions. Show all of the needed to find the model algebraically.

1. It is determined that a normal person cannot survive barometric pressure less than 15. The barometric pressure at sea level is 29.5. At Mile High Stadium in Denver, the pressure is 245. Assuming an exponential model, could someone survive Mt Everest (29,028 feet) without training? What is the highest mountain someone could survive? 1 mile = 5280 feet

2. North Wales had 4,500 people living there in 1980. In 1995, there were 5,100 people living there. Assuming the population grows exponentially, find a model to represent this situation.
   a) How many people are living there in 2015?

   b) In what year will there be 7,500 people living there?

3. It has been shown that when an oil tanker stops its engines, its velocity decreases exponentially. Suppose that a captain shuts off the engines when the speed of a tanker is 20mph. One minute later, the speed of the tanker is 18 mph. What is the speed of the tanker after one hour?

4. Psychologists have long held that much about human nature can be learned from rats. Suppose an experimenter places a rat in a maze. During the initial trial, it takes the rat two minutes to escape. During the second trial, it takes the rat 1 minute, 45 seconds to escape. How long will it take the rat to escape after the 20th trial (in seconds)? How many trials will it take the rat to escape in under 5 seconds?

5. The Law and Order detectives entera house at 11:30 AM and find a man on the floor murdered. They take his body temperature finding it to be $91.8^\circ$. The body is taken to the morgue and, at 12:30 PM, the body temperature is $84.4^\circ$. Using an exponential model for body temperature, to the nearest minute, what time was he killed? Normal body temperature is $98.6^\circ$.

For problems 6–8, use a graphing calculator to find an appropriate model. Use your model to answer the questions.

6. A student is trying to determine the half-life of radioactive iodine-131. He measures the amount of iodine-131 in a sample solution every 8 hours. His data are shown to the right.
   a) What is an appropriate exponential model for this data?

   b) Use your model to find the half-life of iodine-131.

| Time (h) | Amount of $^{131}I$ (g) |
|---|---|
| 0 | 4.80 |
| 8 | 4.66 |
| 16 | 4.51 |
| 24 | 4.39 |
| 32 | 4.29 |
| 40 | 4.14 |
| 48 | 4.04 |

7. A study by the U.S. Office of Science and Technology in 1972 estimated the cost of reducing automobile emissions by certain percentages. Find an exponential equation that models the data shown in the table below. Graph the model and a scatterplot of the data on your calculator. Why do you think the trend of this data is considered to be an example of "diminishing returns"?

| Reduction in emissions (%) | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cost per car ($) | 45 | 55 | 62 | 70 | 80 | 90 | 100 | 200 | 375 | 600 |

8. The table gives the areas of several caves in central Mexico and the number of bat species that live in each cave.
   a) Find an exponential model, a power model, and a natural log model.

   b) On your calculator, graph a scatter plot of the data and all three models you found. Which model fits the data the best? How did you decide?

   c) The cave called El Sapo near Puebla, Mexico, has a surface area of $205\ \text{m}^2$. Estimate the number of bat species you would expect to find in that cave using the best model from part b).

| Cave | Area ($m^2$) | Number of Species |
|---|---|---|
| La Escondida | 18 | 1 |
| El Escorpion | 19 | 1 |
| El Tigre | 58 | 1 |
| Mision Imposible | 60 | 2 |
| San Marin | 128 | 5 |
| El Arenal | 187 | 4 |
| El Ciudad | 344 | 6 |
| Virgen | 511 | 7 |