Name KEY

Precalculus Unit 4: 4.6 Homework
Nonlinear Models

1. The following data gives the box office gross for the first 12 weeks of the 2017 movie *Wonder Woman*.

Week	Box Office Gross (in millions)
1	103.3
2	58.5
3	41.3
4	24.9
5	15.7
6	9.8
7	6.8
8	4.6
9	3.3
10	2.3
11	1.4
12	1.1
Source: boxofficemojo.com	

a. View a scatter plot of data on your graphing utility to determine the shape of the data.

Exponential Decay

b. Determine the type of model that best fits this data set. Use your graphing utility to find the best *model and record it below.*

$y = 133.642e^{-.4123x}$

c. Use the model to predict the box office gross in week 15. Is this interpolation or extrapolation?

(15, .275) ≈ $275,000

.275 million = ↑

2. After a person takes medicine, the amount of drug left in the person's body decreases over time. When testing a new drug, a pharmaceutical company develops a mathematical model to quantify this relationship. To find such a model, suppose a dose of 1000 mg of a certain drug is absorbed by a person's bloodstream. Blood samples are taken every five hours, and the amount of drug remaining in the body is calculated. Possible data from an experiment are shown in the table below.

Drug Absorption Data

Hours Since Drug was Administered	Amount of Drug in Body (mg)
0	1000
5	550
10	316
15	180
20	85
25	56
30	31

a. View a scatter plot of data on your graphing utility to determine the shape of the data.

Exponential Decay

b. Determine the type of model that best fits this data set. Use your graphing utility to find the best model and record it below.

$y = 991.709e^{-.116454x}$

c. According to your model, what is the amount of drug in the body 5 hours after the drug is administered? How does this compare to the actual amount?

(5, 553.998) 553.998 mg

d. At what point will the amount of drug remaining in the body drop below 10 mg?

(39.474, 10) after 39.474 hours.

3. Due to advances in medicine and higher standards of living, life expectancy has been increasing in most developed countries since the beginning of the 20th century.

The table below shows the average life expectancies, in years, of Americans from 1900–2010.

Year	1900	1910	1920	1930	1940	1950
Life Expectancy(Years)	47.3	50.0	54.1	59.7	62.9	68.2
Year	1960	1970	1980	1990	2000	2010
Life Expectancy(Years)	69.7	70.8	73.7	75.4	76.8	78.7

Source: *Center for Disease Control and Prevention, 2013*

a. Let x represent time in decades starting with $x = 1$ for the year 1900, $x = 2$ for the year 1910, and so on. Let y represent the corresponding life expectancy. Use logarithmic regression to fit a model to these data. Record your model below.

$$y = 42.5272 + 13.8575 \ln x$$

b. Use the model to predict the average American life expectancy for the year 2018. How does this compare with the actual life expectancy of Americans in 2018? (You'll have to look this up.)

(12.8, 77.856) 77.9 yrs from model

78.69 yrs. actual

c. Use the model to predict the average American life expectancy for the year 2030.

(14, 79.098) 79.1 yrs.