HW – APPLICATIONS DAY 1

NAME Key 2017

1. Annual sales for a fast food restaurant are $650,000 and are increasing at a rate of 4% each year. Write an exponential function to model the sales.

$\boxed{y = 650{,}000(1.04)^x}$

a) What are the sales after 7 years?

$650{,}000(1.04)^7$

$\boxed{\$855{,}355.66}$

b) After how many years will the sales be $1,000,000?

$1{,}000{,}000 = 650{,}000(1.04)^x$

$\frac{20}{13} = 1.04^x$

$\log_{1.04} \frac{20}{13} = x$

$x = 10.98$

$\boxed{\sim 11 \text{ years}}$

2. The population of a town is 2500 people and is decreasing at a rate of 3.5% each year. Write an exponential function to model the population.

$\boxed{y = 2500(.965)^x}$

a) What is the population of town after 5 years?

$2500(.965)^5$

$\boxed{\sim 2092}$

b) When will only half the population be left?

$1250 = 2500(.965)^x$

$\frac{1}{2} = .965^x$

$\log_{.965} \frac{1}{2} = x$

$\boxed{x = 19.5 \text{ yrs}}$

3. A photocopier is purchased for $5200, and its value each year is about 80% of the value of the preceding year.

a) What is the value of the machine after 3 years? 5 years? 10 years?

3 yrs: $5200(.8)^3 = \boxed{\$2662.40}$

5 yrs: $5200(.8)^5 = \boxed{\$1703.94}$

10 yrs: $5200(.8)^{10} = \boxed{\$558.35}$

b) Approximately when will the value be only $100?

$100 = 5200(.8)^x$

$\frac{1}{52} = .8^x$ → $\log_{.8} \frac{1}{52} = x$

$\boxed{x \approx 18 \text{ yrs}}$

4. A certain satellite has a power supply whose output in watts is given by the equation $P = 40e^{\frac{-t}{900}}$, where t is the number of days the battery has operated.

a) If it has operated continuously after the satellite is placed into orbit, how many watts is the battery putting out after one year?

$P = 40e^{-365/900} = \boxed{26.66 \text{ watts}}$

b) If it takes at least 10 watts to operate the satellite, how many days can the satellite be used?

$10 = 40e^{-t/900}$

$.25 = e^{-t/90}$

$\ln .25 = -t/900$

$900 \ln .25 = -t$

$\boxed{t = 1247.7 \text{ days} \quad \sim 3.5 \text{ yrs}}$

5. A woman buys an apartment house for \$5 million as a tax shelter. She wants to depreciate the building at such a rate that it will be worth only \$1 million after 7 years.

a) What rate of depreciation should she claim on her income tax form?

$1{,}000{,}000 = 5{,}000{,}000(1-r)^7$

$\frac{1}{5} = (1-r)^7$

$.7946 = 1-r$

$-.205 = -r$

$\boxed{r \approx 20.5\%}$

b) If she wanted to claim 15% depreciation per year, how long would it take to depreciate to \$1 million?

$1{,}000{,}000 = 5{,}000{,}000(.85)^x$

$1/5 = .85^x$

$\log_{.85} 1/5 = x$

$\boxed{x \approx 9.9 \text{ yrs}}$

6. The exponential growth rate of the population of Europe west of Russia is 1% each year. What is the doubling time?

$2 = 1(1+.01)^x$

$2 = 1.01^x$

$\log_{1.01} 2 = x$

$\boxed{x \approx 70 \text{ yrs}}$

7. Anna purchased her house in 1972 for \$35,000. If the value of real estate increases at a rate of 15% per year, when, to the nearest year, will her house be worth \$300,000?

$300{,}000 = 35{,}000(1.15)^x$

$8.57 = 1.15^x$

$\log_{1.15} 8.57 = x$

$\boxed{x = 15.37 \text{ yrs} \approx 1987}$

8. Suppose a Cadillac depreciates at 18% a year.

a) How long does it take for the car to be worth half of its original price?

$1/2 = 1(.82)^x$

$1/2 = .82^x$

$\log_{.82} 1/2 = x$

$\boxed{x \approx 3.5 \text{ yrs}}$

c) What percent of its original price is it worth after 5 years?

$y = 1(.82)^5$

$y = .37$

$\boxed{37\% \text{ of original price}}$