

3.5 Applications of Exponential & Logarithmic Functions 41 points total

All work must be shown to receive credit. Refer the instructions within each problem to round your answers.

1. The number V of computers infected by a computer virus increases according to the model $V(t) = 100e^{4.6052t}$, where t is the time in hours. Find the following, and round to the nearest whole number. 2 pts each
- (a) $V(1)$ (b) $V(1.5)$ (c) $V(2)$

2. Let Q represent a mass of radioactive radium (^{226}Ra) (in grams), whose half-life is 1599 years. The quantity of radium present after t years is $Q = 25 \left(\frac{1}{2}\right)^{\frac{t}{1599}}$
- (a) Determine the initial quantity (when $t = 0$). Round to the nearest hundredth if necessary. 2 pts

- (b) Determine the quantity present after 1000 years. Round to the nearest hundredth if necessary. 2 pts

3. The relationship between the number of decibels β and the intensity of sound I in watts per square meter is $\beta = 10 \log\left(\frac{I}{10^{-12}}\right)$
- (a) Determine the number of decibels of a sound with an intensity of 1 watt per square meter. Round to the nearest hundredth, if necessary. 2 pts

(b) Determine the number of decibels of sound with an intensity of 10^{-2} watt per square meter. Round to the nearest hundredth, if necessary. 2 pts

4. \$2500 is invested in an account at interest rate of 8.5%, compounded continuously. Find the time required for the amount to do the following. Round to the nearest whole number. 2 pts each
- (a) double (b) triple

5. Students participating in a psychology experiment attended several lectures and were given an exam. Every month for a year after the exam, the students were retested to see how much of the material they remembered. The average scores for the group can be modeled by the human memory model $f(t) = 90 - 15\log(t + 1)$, $0 \leq t \leq 12$ where t is time in months.
- (a) Use the properties of logarithms to write the function in another form. 2 pts

(b) What was the average score on the original exam? Round to the nearest hundredth, if necessary. 3 pts

(c) What was the average score after 6 months? Round to the nearest hundredth, if necessary. 2 pts

6. Determine the principal P that must be invested at an interest rate of $7\frac{1}{2}\%$, compounded monthly, so that \$500,000 will be available for retirement in 20 years. Round to the nearest hundredth. 2 pts

7. Determine the time necessary for \$1,000 to double if it is invested at an interest rate of 11% compounded the following ways.

Round to the nearest hundredth. 2 pts each

(a) annually

(b) monthly

(c) daily

(d) continuously

8. The population P (in thousands) of Pittsburgh, Pennsylvania from 2000 to 2003 can be modeled by $P = 243e^{-0.0029t}$, where t represents the year, with $t = 0$ corresponding to 2000.

(a) What was the population in Pittsburgh in 2000 and in 2003? Round to the nearest whole number. 4 pts

(b) According to the model, was the population of Pittsburgh increasing or decreasing from 2000 to 2003? *Explain your answer.* 2 pts