Precalculus Name: Key

Practice With Exponential Growth & Decay (2.9)

1. Determine whether each of the following represents an exponential growth function or exponential decay function, and find the constant percentage rate of growth or decay.

a. $P(t) = 3.5 \cdot 1.09^t$
growth / decay & r = 9%

b. $P(t) = 4.3 \cdot 1.018^t$
growth / decay & r = 1.8%

c. $f(x) = 78{,}963 \cdot 0.968^x$
growth / decay & r = 3.2%

d. $f(x) = 5607 \cdot 0.9968^x$
growth / decay & r = .32%

e. $g(t) = 247 \cdot 2^t$
growth / decay & r = 100%

f. $g(t) = 43 \cdot 0.05^t$
growth / decay & r = 95%

2. Determine the exponential function that satisfies the given conditions:

a. Initial value = 5, increasing at a rate of 1.7% per year
$f(x)=5(1.017)^x$

b. Initial value = 52, decreasing at a rate of 2.3% per day
$f(x)=50(.977)^x$

c. Initial mass = 0.6 g, doubling every 3 days
$f(x)=.6(2)^{\frac{x}{5}}$

d. Initial population = 250, halving every 7.5 hours
$f(x)=250\left(\frac{1}{2}\right)^{\frac{x}{7.5}}$

3. Find a logistic function of the form: $f(x)=\dfrac{c}{1+a\bullet b^x}$ satisfying the following conditions: ***No Calculator***

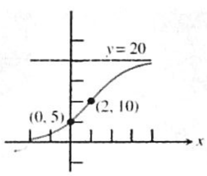
a. Initial value = 10
limit to growth = 40
passing through (1, 20)

$$f(x)=\frac{40}{1+3\left(\frac{1}{3}\right)^x}$$

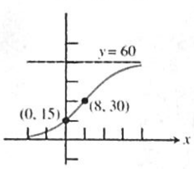
b. Initial value = 12
limit to growth = 60
passing through (1, 24)

$$f(x)=\frac{60}{1+4\left(\frac{3}{8}\right)^x}$$

4. Determine a formula for the logistic function of the form: $f(x)=\dfrac{c}{1+a\bullet b^x}$ whose graph is shown in the figure below.



a. $f(x)=\dfrac{20}{1+3\left(\frac{1}{3}\right)^{\frac{1}{2}x}}$



b. $f(x)=\dfrac{60}{1+3\left(\frac{1}{3}\right)^{\frac{1}{8}x}}$

5. The number of students infected with the swine flu at HSHS after t days is modeled by the function $f(t)=\dfrac{800}{1+49\bullet e^{-0.2t}}$

a. How many students were sick when the outbreak started? 16

b. When will the number of infected students be 200? 13.96 days

c. What is the maximum number students that could be infected? 800

6. The number of stray cats in town t days after an accident involving a truck hauling raw fish, is modeled by $f(t)=\dfrac{308}{1+27\bullet 0.79^t}$

a. How many stray cats were in town before the accident? 11

b. When will the number of stray cats be 200? 16.6 days

c. What is the maximum number of stray cats that could survive in town? 308

7. Suppose that an experimental population of fruit flies increases exponentially. The population began with 100, & after 2 days the population reached 300 flies.

a. Write a model, $P(t)$, to represent the situation:

$P(t)=100(\sqrt{3})^t$
or $P(t)=100(3)^{t/2}$

b. How many flies will be present in 10 days? 24,300

c. How long will it take for the population to reach a billion? 58.7 days

8. Assume that the number of bacteria in a bacterial culture doubles every hour and that there are 1,000 present initially.

a. Identify the Variables: p_o = 1000 r = 100%

b. Write an equation describing this growth pattern: $P(t) = 1000(2)^{t}$

c. How many bacteria are present after 8 hours and 15 minutes? 304,437

d. Determine when the number of bacteria will be 1 million. 9.97 hours

9. Assume that the number of bacteria in a bacterial culture triples every 2 hours and that there are 1,000 present initially.

a. Identify the Variables: p_o = 1000 r = 200%

b. Write an equation describing this growth pattern: $P(t) = 1000(3)^{\frac{t}{2}}$

c. How many bacteria are present after 8 hours and 15 minutes? 92,923

d. Determine when the number of bacteria will be 1 million. 12.6 hours

10. The population of a town is 100,000 and increasing at the rate of 2.15% a year.

a. Identify the Variables: p_o = 100000 r = 2.15%

b. Write an equation describing this growth pattern: $P(t) = 100000(1.0215)^{t}$

c. How many people are present after 10 years? $P(10) = 123{,}703$

d. Determine when the population will have doubled. 4.54 years

11. The population of Allentown, PA was 5,000 in 1900 and has steadily grown by 12.68% every 4 years since.

a. Identify the Variables: p_o = 5000 r = 12.68%

b. Write an equation describing this growth pattern: $P(t) = 5000(1.1268)^{\frac{t}{4}}$

c. How many people live in Allentown in 2008? $P(108) = 125{,}555$

d. Determine when the population will reach 150,000 28.5 years

12. The population of a small, western town in the year 1860 was 7,500 and decreasing at the rate of 3.85% every two years.

a. Identify the Variables: p_o = 7500 r = 3.85%

b. Write an equation describing this decay pattern: $P(t) = 7500(.9615)^{\frac{t}{2}}$

c. How many people lived in the town in 1935? $P(75) \approx 1722.5$

d. Determine when the population will have been cut in half. 35.3 years

13. The half-life of carbon-14 is 5,730 years. Assume that a typical male has 35 pounds of carbon-14 in his body at death.

a. Write an equation describing this decay pattern: $P(t) = 35\left(\frac{1}{2}\right)^{t/5730}$

b. How much carbon-14 will remain after 1,000 years? 31.01 pounds

c. How many years will it take to have only 1lb of carbon-14 left? 29390.8yrs.

d. If a person who died on January 1, 000 were found today, how much carbon-14 would be remaining? 30.9g

14. Not all half-lives are that long. Some elements have relatively small half-lives. In the following table are some basic elements and their half-lives. If you started with 1,000g of each element determine how much of each would remain after 2 minutes.

Element	Half-Life (in seconds)	Amount Remaining (after 2 min)
Neon-23	37.24	107.1g
Oxygen-10	26.91	45.4g
Beryllium-11	13.81	2.4g
Nitrogen-16	7.13	.00805g
Carbon-15	2.5	3.5×10^{-12}g

15. It is determined that a normal person without training 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 24.5.

a. Assuming an exponential model, could someone survive Mt. Everest (29,028 feet) without training? NO 10.6

b. What is the highest mountain someone without training could survive? 19228.6ft, 3.64miles

16. Some doctors use particular scale to determine the amount of a drug in someone's bloodstream. Immediately after taking the drug a person's blood would read 100 on the scale. Six hours later, his/her blood will read a 78.

a. Assuming an exponential model, $S(t)$, write an equation representing the situation $S(t) = 100(.995)^{t}$

b. What will be the scale reading 12 hours later? 57.76

c. What will be the scale reading 24 hours later? 33.36

d. What will be the scale reading 1 week later? .046

e. If someone's reading was 54, estimate the time when they last took the drug? 13.47