A2.A.6: Exponential Growth 1: Solve an application which results in an exponential function

1 The growth of bacteria in a dish is modeled by the function $f(t) = 2^{\frac{t}{3}}$. For which value of t is $f(t) = 32$?
1) 8
2) 2
3) 15
4) 16

2 A population of rabbits doubles every 60 days according to the formula $P = 10(2)^{\frac{t}{60}}$, where P is the population of rabbits on day t. What is the value of t when the population is 320?
1) 240
2) 300
3) 660
4) 960

3 Given a starting population of 100 bacteria, the formula $b = 100(2^t)$ can be used to find the number of bacteria, b, after t periods of time. If each period is 15 minutes long, how many minutes will it take for the population of bacteria to reach 51,200?

4 Growth of a certain strain of bacteria is modeled by the equation $G = A(2.7)^{0.584t}$, where:

G = final number of bacteria

A = initial number of bacteria

t = time (in hours)

In approximately how many hours will 4 bacteria first increase to 2,500 bacteria? Round your answer to the *nearest hour*.

5 Drew's parents invested $1,500 in an account such that the value of the investment doubles every seven years. The value of the investment, V, is determined by the equation $V = 1500(2)^{\frac{t}{7}}$, where t represents the number of years since the money was deposited. How many years, to the *nearest tenth of a year*, will it take the value of the investment to reach $1,000,000?

6 In the equation $y = 0.5(1.21)^x$, y represents the number of snowboarders in millions and x represents the number of years since 1988. Find the year in which the number of snowboarders will be 10 million for the first time. (Only an algebraic solution will be accepted.)

7 The number of houses in Central Village, New York, grows every year according to the function $H(t) = 540(1.039)^t$, where H represents the number of houses, and t represents the number of years since January 1995. A civil engineering firm has suggested that a new, larger well must be built by the village to supply its water when the number of houses exceeds 1,000. During which year will this first happen?

8 Currently, the population of the metropolitan Waterville area is 62,700 and is increasing at an annual rate of 3.25%. This situation can be modeled by the equation $P(t) = 62,700(1.0325)^t$, where $P(t)$ represents the total population and t represents the number of years from now. Find the population of the Waterville area, to the *nearest hundred,* seven years from now. Determine how many years, to the *nearest tenth*, it will take for the original population to reach 100,000.
[Only an algebraic solution can receive full credit.]

9 Susie invests $500 in an account that is compounded continuously at an annual interest rate of 5%, according to the formula $A = Pe^{rt}$, where A is the amount accrued, P is the principal, r is the rate of interest, and t is the time, in years. Approximately how many years will it take for Susie’s money to double?

1) 1.4
2) 6.0
3) 13.9
4) 14.7

10 Akeem invests $25,000 in an account that pays 4.75% annual interest compounded continuously. Using the formula $A = Pe^{rt}$, where A = the amount in the account after t years, P = principal invested, and r = the annual interest rate, how many years, to the *nearest tenth*, will it take for Akeem’s investment to triple?

1) 10.0
2) 14.6
3) 23.1
4) 24.0

11 Sean invests $10,000 at an annual rate of 5% compounded continuously, according to the formula $A = Pe^{rt}$, where A is the amount, P is the principal, $e = 2.718$, r is the rate of interest, and t is time, in years. Determine, to the *nearest dollar*, the amount of money he will have after 2 years. Determine how many years, to the *nearest year*, it will take for his initial investment to double.

12 The number of bacteria present in a Petri dish can be modeled by the function $N = 50e^{3t}$, where N is the number of bacteria present in the Petri dish after t hours. Using this model, determine, to the *nearest hundredth*, the number of hours it will take for N to reach 30,700.

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Answer Section

1 ANS: 3 REF: 080502b

2 ANS: 2

$$320 = 10(2)^{\frac{t}{60}}$$
$$32 = (2)^{\frac{t}{60}}$$
$$\log 32 = \log(2)^{\frac{t}{60}}$$
$$\log 32 = \frac{t\log 2}{60}$$
$$\frac{60\log 32}{\log 2} = t$$
$$300 = t$$

REF: 011205a2

3 ANS:
135

REF: 010923b

4 ANS:
11

REF: 060224b

5 ANS:
65.7

REF: 080729b

6 ANS:
2004

REF: fall9930b

7 ANS:
2011

REF: 010828b

8 ANS:
78,400, 14.6

REF: 011031b

9 ANS: 3

$$\begin{aligned} 1000 &= 500e^{.05t} \\ 2 &= e^{.05t} \\ \ln 2 &= \ln e^{.05t} \\ \frac{\ln 2}{.05} &= \frac{.05t \cdot \ln e}{.05} \\ 13.9 &\approx t \end{aligned}$$

REF: 061313a2

10 ANS: 3

$$\begin{aligned} 75000 &= 25000e^{.0475t} \\ 3 &= e^{.0475t} \\ \ln 3 &= \ln e^{.0475t} \\ \frac{\ln 3}{.0475} &= \frac{.0475t \cdot \ln e}{.0475} \\ 23.1 &\approx t \end{aligned}$$

REF: 061117a2

11 ANS:
11052, 14

REF: 060330b

12 ANS:

$$\begin{aligned} 30700 &= 50e^{3t} \\ 614 &= e^{3t} \\ \ln 614 &= \ln e^{3t} \\ \ln 614 &= 3t \ln e \\ \ln 614 &= 3t \\ 2.14 &\approx t \end{aligned}$$

REF: 011333a2