Worksheet on Solving Problems on Exponential Functions

Short Answer

1. A group of yeast cells doubles every 4 h. There is a population of 100 at 10 a.m. Write the function that models the growth of the population. Determine the population at 5 p.m.

2. A baker records the internal temperature of a pie that has been left to cool on a counter. The room temperature is 14°C. An equation that models this situation is \( T(t) = 68(0.5)^{t/4} + 14 \) where \( T \) is the temperature in degrees Celsius and \( t \) is the time in minutes. Determine the temperature, to the nearest degree, of the pie after 15 minutes. How much time did it take for the pie to reach an internal temperature of 31°C?

3. A laptop computer loses its value each month after it is purchased. Its value as a function of time, in months, is modelled by \( V(m) = 3800(0.92)^m \). What is the value of the laptop after 3 months? In which month after it is purchased does the laptop’s worth fall below $2000?

4. A 90 g sample of plutonium-238 has a half-life of 88 years. How long will it take for this sample to decay to 40 g?

5. The population of a town has grown at an annual rate of approximately 2.7%. How long will it take for its population of 18 450 people to double at this growth rate? Explain how you found your answer.
6. In 2001, a sum of $4000 is invested at a rate of 6.5% per year for 5 years. What is the value of the investment when it matures? Explain how you found your answer.

7. A species of bacteria has a population of 250 at 6 a.m. It doubles every 8 h. Determine the function that models the growth of the population. Determine the population at 9 p.m.

**Problem**

8. A population of yeast cells can double in 2 h. Assume an initial population of 120 cells.
   a) What is the growth rate, in percent per hour, of this colony of yeast cells?
   b) Write an equation that can be used to determine the population of cells at \( t \) hours.
   c) Use your equation to determine the population after 12 hours.
   d) Use your equation to determine the population after 210 min.
   e) Approximately how many hours would it take for the population to reach 500 000 cells?
   f) What are the domain and range for this situation?

9. An antique painting is purchased in 1980 for $995. The value increases by 3.1% every year.
   a) Write an equation that models the value of the painting after \( t \) years.
   b) Determine the increase in value of the painting in the 6th year after it was purchased (from year 5 to year 6).
   c) Determine the increase in value of the painting in the 25th year after it was purchased.
A town has a population of 12,600 in 1995. Twelve years later, its population grew to 19,000. Determine the average annual growth rate of this town’s population.
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Answer Section

SHORT ANSWER

1. ANS: \( P(t) = 100 \left( \frac{1}{2} \right)^t \), 336

   PTS: 1   REF: Thinking   OBJ: 4.7 - Applications Involving Exponential Functions

2. ANS: 38°C; 20 min

   PTS: 1   REF: Application   OBJ: 4.7 - Applications Involving Exponential Functions

3. ANS: $2959.01; after month 7

   PTS: 1   REF: Application   OBJ: 4.7 - Applications Involving Exponential Functions

4. ANS: about 103 years

   PTS: 1   REF: Thinking   OBJ: 4.7 - Applications Involving Exponential Functions

5. ANS: about 26 years; I determined the function to model the population growth as \( P(t) = 18450(1.027)^t \) where \( P(t) \) represents the population after \( t \) years. I then used my calculator to guess and check the number of years until I reached 36 900.

   PTS: 1   REF: Communication   OBJ: 4.7 - Applications Involving Exponential Functions

6. ANS: $5480.35; I determined the function to model the interest as \( I(t) = 4000(1.065)^t \) where \( I(t) \) represents the investment amount after \( t \) years. I then substituted 5 for \( t \) and evaluated the function to get the answer.

   PTS: 1   REF: Communication   OBJ: 4.7 - Applications Involving Exponential Functions

7. ANS: \( P(t) = 250 \left( \frac{1}{2} \right)^t \), 917

   PTS: 1   REF: Thinking   OBJ: 4.7 - Applications Involving Exponential Functions

PROBLEM

8. ANS:
a) The population increases 50% per hour. The growth rate is 150% per hour.

\[ P(t) = 120 \left( 2^{\frac{t}{3}} \right) \]

b) 
c) 7680
d) about 404
e) about 24 h
f) Domain = \{ x \in \mathbb{R} \mid x \geq 0 \}; \ Range = \{ y \in \mathbb{I} \mid y \geq 120 \}

PTS:  1  
REF:  Application  
OBJ:  4.7 - Applications Involving Exponential Functions

9. ANS:

a) \[ P(t) = 995(1.031)^t \]
b) $35.91
c) $64.18

PTS:  1  
REF:  Application  
OBJ:  4.7 - Applications Involving Exponential Functions

10. ANS:

\[ P(t) = 12600(1.034819)^t \]

PTS:  1  
REF:  Thinking  
OBJ:  4.7 - Applications Involving Exponential Functions