

Math II

Writing Exponential Expressions in Equivalent Forms.

**For problems 1 and 2, read the following scenario and use the information in it to answer the questions.**

*A town's population has increased 35% during the last 8 years and is now 50,100 people.*

1. What was the population 8 years ago?

$$\frac{\text{New}}{\text{old}} = \frac{1+r}{1} \quad \frac{50100}{x} \times \frac{1+.35}{1} \quad \frac{1.35x}{1.35} = \frac{50100}{1.35}$$

$$x = 37,111$$

2. Assuming that the population increased at the same rate each year, what was the annual rate of increase?

$$P = 37,111 (1+.35)^{t/8} \quad (1.35^{1/8})^t \rightarrow (1.0382)^t \quad 1.0382 - 1 = .0382$$

$$3.82\%$$

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For problems 3 - 5, read the following scenario and use the information in it to answer the questions.

Yesinia paid \$26,500 for a new car in June 2005. The car was worth \$10,600 in June 2011.

3. Assuming a constant annual rate of decrease in value, what was the annual rate of decrease?

$$\frac{10600}{26500} = \frac{1+r}{1} \quad \left. \begin{array}{l} .4 = 1+r \\ -1 \quad -1 \\ \hline -.6 = r \end{array} \right| \quad \begin{array}{l} 26500(1-.6)^{t/6} \\ (.4^{1/6})^t \\ (.8584)^t \end{array} \quad \begin{array}{l} .8584 - 1 = -.1416 \\ \text{w} \\ \boxed{-14.16\%} \end{array}$$

4. What was the value of the car in June 2008?

$$26500(1-.1416)^t$$

$$26500(.8584)^3 = \boxed{\$16,761.58}$$

5. What is the predicted value for June 2020?

$$26500(.8584)^{15} = \boxed{\$2,682.82}$$

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For problems 5–8, use what you’ve learned about exponential growth and decay to answer the questions.

5. The Best Service Heating Fuel Company had 1,418 of its customers signed up to pay their bills online as of May 1, 2012, which represented an increase of 185% since May 1, 2005. Assuming that the number of sign-ups increased at the same rate each year, how many Best Service customers were signed up to pay their bills online as of May 1, 2008?

$$\begin{array}{l}
 \frac{1418}{x} \times \frac{1+1.85}{1} \\
 \frac{2.85x = 1418}{2.85} \quad \frac{1418}{2.85} \\
 x = 497
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 497(1+1.85)^{t/7} \\
 (2.85^{1/7})^t \\
 (1.1614)^t \\
 1.1614 - 1 = .1614 \\
 16.14\%
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 497(1+.1614)^t \\
 497(1.1614)^3 \\
 \boxed{\approx 778}
 \end{array}$$

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6. A news paper had 144,800 print subscribers on December 31, 2002. It had 54,300 print subscribers on December 31, 2012. Assuming a constant annual rate of decrease, how many print subscribers did the newspaper have on December 31, 2007? What is the predicted number of print subscribers on December 31, 2020?

$$\frac{54300}{144800} = \frac{1+r}{1}$$

$$\frac{.375}{-1} = \frac{1+r}{-1}$$

$$-.625 = r$$

$$144800(1-.625)^{t/10}$$

$$(.375^{1/10})^t$$

$$(.9066)^t$$

$$.9066 - 1$$

$$= -.0934$$

$$= -9.34\%$$

$$144800(1-.0934)^t$$

$$144800(.9066)^{18} \approx 24,788$$



7. The value of Mr. Cooper's house on July 1, 1990, was \$80,200. The value on July 1, 2010, was \$252,630. Assuming a constant annual rate of increase, what was the value on July 1, 2005? What is the predicted value on July 1, 2020?

$$\frac{252630}{80200} = \frac{1+r}{1}$$

$$3.15 = 1+r$$

$$-1 \quad -1$$

$$r = 2.15$$

$$80200(1+2.15)^t$$

$$(3.15^{1/20})^t$$

$$(1.0590)^t$$

$$1.0590 - 1 = .0590$$

$$5.9\%$$

2005

$$80200(1+.059)^t$$

$$80200(1.059)^{15}$$

$$\approx \$189501.99$$

2020

$$80200(1.059)^{30}$$

$$\$447,768.12$$

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8. Jared is comparing two different investments. One is a bank account that pays 3.4% annual interest, compounded annually. The other is a loan that pays 1.25% quarterly interest, compounded quarterly. For each investment, what is the approximate equivalent monthly rate, compounded monthly?

$$(1 + .034)^{t/12}$$

$$(1.034^{1/12})^t$$

$$(1.0028)^t$$

$$1.0028 - 1 = .0028$$

.28%  
Monthly

$$(1 + .0125)^{t/3}$$

$$(1.0125^{1/3})^t$$

$$(1.0041)^t$$

$$1.0041 - 1 = .0041$$

.41%  
Monthly

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For problems 9 and 10, read the following scenario and use the information in it to answer the questions.

Anjali has money to invest. She is considering two investment options. One option is to lend money to a start-up software company that will pay 0.4% monthly interest, compounded monthly. The other option is to deposit money in a bank account that pays 3.6% annual interest, compounded annually.

9. For the option of lending to the start-up company, what is the approximate equivalent annual interest rate, compounded annually?

$$(1 + .004)^{12} = 1.0491$$

$$1.0491 - 1 = .0491$$

4.91% Annually

10 Suppose Anjali plans to invest \$15,000 for 6 years in one of the options. What would be the value of her investment under each option?

Start-up

$$15000(1 + .0491)^6$$

\$19,998.28

Bank

$$15000(1 + .036)^6$$

\$18,545.98