Exponential Functions
Section 11-2b

Exponential functions are used every day in the world of finance. Investing and borrowing are the business of banks. Banks make money by charging a fee every time a client borrows money from them. This fee is called an interest rate and these fees can be quite large if the sum of money being borrowed is large. Most banks state interest rates as annual percentage rates or APRs.

Large amounts of borrowed or invested money are called annuities. Annuities are a series of equal payments made at equal intervals of time. Some examples of annuities are retirement plans, mortgages and car loans.

Two formulas are often used to calculate the present value or future value of an annuity.

The present value of an annuity can be found using the formula:

\[ P_n = P \left( \frac{1-(1+i)^{-n}}{i} \right) \]

where \( P_n \) is the present value of an annuity, \( n \) is the number of payments, \( P \) is the amount of each payment and \( i \) represents the interest rate per payment interval. Where \( i = \frac{APR}{\text{number of payments per year}} \).

The future value of an annuity can be found using the formula:

\[ F_n = P \left( \frac{(1+i)^n - 1}{i} \right) \]

where \( F_n \) is the future value of an annuity, \( n \) is the number of payments, \( P \) is the amount of each payment and \( i \) represents the interest rate per payment interval. Where \( i = \frac{APR}{\text{number of payments per year}} \).
Example: The Wimberlys have taken a 30-year mortgage for $100,000, with an interest rate of 9.0%, on their new home. How much will the monthly payment for the principal and interest be?

Use \( P_n = P \left(1 - (1+i)^{-n}\right)i \) because you want to find out how much they will be paying each month.

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P_n = \text{______________}
\]

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i = ______ = ______ = ______
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n = ______ \cdot ______ = ______
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Example: When Jim Baldini started his first job after he finished college, he opened an individual retirement account (IRA). He plans to contribute $2500 per year for 38 years until he reaches age 62. He hopes to earn an average APR of 8% over the 38-year period. If Mr. Baldini contributes to his IRA at the rate that he plans, how much will his account be worth when he is 62 years old?

Use the future value of an annuity because you want to find the total amount Mr. Baldini will have in the future.

\[ F_n = P \left( \frac{(1+i)^n - 1}{i} \right) \]

\[ P = \text{________} \]

\[ i = \text{______} = \text{______} = \text{________} \]

\[ n = \text{________} \]