Name:

APPLICATION: How Long Does it Take to Meet your Goals?

Level 1

While diversifying her portfolio, Noelle decides to invest $12,500 into a mutual fund. Historically, the mutual fund has yielded 7% interest annually.

1. **Write an exponential equation to model this situation where x represents years and f(x) represents the amount of money in the mutual fund after x years.**

2. **If Noelle's goal was to grow your investment to $21,000, how many years would it take for her investment to reach this goal? (Hint: Convert your equation into logarithmic form and use the change of base formula.)**

3. **Noelle is given the option to invest an additional $2,500 (for a total of $15,000) or switch her investment to a different fund that has the potential to yield 10% instead of 7%. If her goal remains the same (reaching $21,000), which option should she choose to reach her goal fastest?**

Level 2

1. **Watch this video about the Rule of 72 then summarize what the Rule of 72 tells us.**

2. **Hanna invested $10,000 in the Fidelity 500 Index Fund (FXAIX), which is an index fund that aligns with the performance of the S&P 500. The average historical rate of return of the S&P 500 is 10.67%. Use the rule of 72 to estimate how long it will take for Hanna's money to double.**

3. **Write an exponential equation that represents Hanna's investment.**

4. **Use logarithms to calculate exactly long it will take for Hanna to double her investment.**

5. **Show how closely the rule of 72 was to the actual exact answer by performing a percent error calculation.**

$$\%\ error\ =\ \left|\frac{actual\ -\ estimated}{actual}\right|$$

6. **When would it be appropriate to use the Rule of 72 instead of calculating the exact time.**

Level 3

FIRE stands for **F**inancial **I**ndependence, **R**etire **E**arly. It's a movement with the goal of individuals being extremely frugal and saving until they have enough money to retire earlier than the common age of 65. FIRE savers use investments to help generate additional income so that they can meet their savings goals sooner and to have passive income streams after retirement.

Amos put $50,000 of his FIRE savings into an index fund that he predicts has an average annual rate of return of 9%. He wants to generate $180,000 as a part of a larger saving strategy before his early retirement date in 15 years.

To calculate the amount of passive income his investment gains annually, he uses the formula $\mathbf{I = [P\ (1 + r)^t] - P}$ where:

- I = Total income
- P = Starting balance (principal)
- r = Rate as a decimal
- t = Time, in years

1. **Substitute the values for Amos' income, principal, and rate into the formula and isolate the base and exponent.**

2. **Use logarithms to calculate how long it will take Amos to earn $180,000 in passive income.**

3. **Did Amos meet his goal of generating $180,000 in interest before his early retirement in 15 years?**

4. **How could Amos shift his investment strategy to meet his 15 years savings goal? Justify your response.**