Unit 5 Lesson 17: Different Compounding Intervals

1 Returns Over Three Years (Warm up)

Student Task Statement

Earlier, you learned about a bank account that had an initial balance of $1,000 and earned 1% monthly interest. Each month, the interest was added to the account and no other deposits or withdrawals were made.

To calculate the account balance in dollars after 3 years, Elena wrote: $1{,}000 \cdot (1.01)^{36}$ and Tyler wrote: $1{,}000 \cdot \left((1.01)^{12}\right)^3$.

Discuss with a partner:

1. Why do Elena's expression and Tyler's expression both represent the account balance correctly?
2. Kiran said, "The account balance is about $1{,}000 \cdot (1.1268)^3$." Do you agree? Why or why not?

2 Contemplating Credit Cards

Student Task Statement

A credit card company lists a nominal APR (annual percentage rate) of 24% but compounds interest monthly, so it calculates 2% per month.

Suppose a cardholder made $1,000 worth of purchases using his credit card and made no payments or other purchases. Assume the credit card company does not charge any additional fees other than the interest.

1. Write expressions for the balance on the card after 1 month, 2 months, 6 months, and 1 year.
2. Write an expression for the balance on the card, in dollars, after m months without payment.
3. How much does the cardholder owe after 1 year without payment? What is the *effective* APR of this credit card?
4. Write an expression for the balance on the card, in dollars, after t years without payment. Be prepared to explain your expression.

3 Which One Would You Choose?

Student Task Statement

Suppose you have $500 to invest and can choose between two investment options.

- Option 1: every 3 months 3% interest is applied to the balance
- Option 2: every 4 months 4% interest is applied to the balance

Which option would you choose? Build a mathematical model for each investment option and use them to support your investment decision. Remember to state your assumptions about the situation.

4 Changes Over the Years (Optional)

Student Task Statement

1. The function f defined by $f(x) = 15 \cdot (1.07)^x$ models the cost of tuition, in thousands of dollars, at a local college x years since 2017.
   a. What is the cost of tuition at the college in 2017?

   b. At what annual percentage rate does the tuition grow?

   c. Assume that before 2017 the tuition had also been growing at the same rate as after 2017. What was the tuition in 2000? Show your reasoning.

   d. What was the tuition in 2010?

   e. What will the tuition be when you graduate from high school?

2. Between 2000 and 2010 the tuition nearly doubled.
   a. By what factor will the tuition grow between 2017 and 2027? Show your reasoning.

   b. Choose another 10-year period and find the factor by which the tuition grows. Show your reasoning.

   c. What can you say about how the tuition changes over any 10-year period (assuming the function f continues to be an accurate model)? Explain or show how you know that this will *always* be the case.