6.4 Functions and Formulas

Study Guide and Exercise Book Pages
120 to 123

Tools
- graphing calculator
- computer algebra system
- large sheets of grid paper
- markers

Related Resources
- T6–5 How to Do Section 6.4 #13 Using TI-Nspire™ CAS

Teaching Suggestions

Key Concepts

- Have students scan the questions in this section and write down any formulas they see. As a class, discuss each of these formulas:
  - Is this a formula we recognize?
  - If it is a common formula, what do the different variables represent?
  - Is this a formula from mathematics, business, or science?
- Have students write important formulas on a **word wall** in the classroom.
- Have students add important formulas to their chapter reference sheets.

Example

- You may wish to have students note some key features of this equation. Note that the number inside the brackets is slightly larger than 1, meaning that the amount deposited into the bank will grow every year.
- You may also want to revisit decimal forms of percents, particularly of fractions of a percent.
- Remind students that the *i*-value, the yearly interest rate, is divided by the same amount by which the *n*-value, the number of years, is multiplied.
- In part **b**), have students use the exact value, $\frac{0.035}{4}$. Do not let them round the value. Show students by how much the final amount would change if they were to round to something, such as 0.009, and discuss whether a bank would round this value. You may even wish to discuss how much a bank would make in extra profits if they rounded down Michael's and all their other customers' interest to the nearest cent.
- For investment questions, revisit terminology, such as annually, semi-annually, quarterly, weekly, and bi-weekly. Some students may not remember how many weeks or days there are in a year.
- Remind students to always write exact formulas. For example, if the rate in this question had been 4% and the loan had been compounded monthly, then the equation would be written as $A = 10\,000\left(1 + \frac{0.04}{12}\right)^{5 \times 12}$, and not $A = 10\,000(1 + 0.003\,33)^{5 \times 12}$.
- Most students will require more practice finding the *i*-values and the *n*-values for these types of problems.

Questions

- You may wish to give students a page of formulas and have them practise rewriting the formulas in terms of a specified variable.
- Challenge students to research on the Internet some other formulas that are used in mathematics.
- This section has a variety of types of application questions. Have students work in groups, where each group becomes an "expert" at one of the types of questions. Provide students with large sheets of grid paper and markers, and allow them time to make a presentation to their classmates. Their group presentations could be marked using a rubric, which could be handed out to students before they make their presentations. Other students would be expected to take notes on the presentations.

Common Errors
- Students tend to blindly trust answers that their calculators generate for application questions.

R_x Show students how they can estimate answers, or determine if their answer looks right. Final answers may also be substituted into another equation to be checked, or compared to a graph of the function.

Differentiated Instruction
- Use **gallery walk** to solve a given equation for a given variable. In this process, each group starts with an equation and completes one step. The groups rotate, adding another step to each question. Groups return to their original station and check the steps that the other groups have completed.

- For **question 1**, help students recall the meaning of the terms *constant* and *variable*. Some students may not realize that π is a constant, because it looks like a letter or a variable to them.
- In **question 2**, remind students to convert the percents to decimals.
- In **question 4**, ask students whether a $\pm$ sign is required in front of the root sign for the answer to part **a**). Why or why not?
- For **question 6**, remind students that functions that are expressed as $V = \frac{1}{3}\pi r^2 h$ can be expressed as $V = \frac{\pi r^2 h}{3}$. This form may make the calculation for the volume of a cone easier to understand.
- Students may have difficulty answering **questions 6d**) and **e**) because there are no x or y variables in the equation.
- For **question 9**, have students support their answer with numerical examples, a table of values, or supporting graphs.
- For **question 12**, have students note the difference between "the amount remaining is reduced *by* a factor of $\frac{1}{5}$" and "the amount remaining is reduced *to* $\frac{1}{5}$ of the original amount."
- Assign **questions 13**, **15**, and **16** to students who require more of a challenge.

Technology Suggestions

- When graphing the functions, encourage students to set the window after they have checked the table of values to determine the range.
- Students may need help using their calculators to evaluate some functions, such as $A = 10\,000\left(1 + \frac{0.035}{4}\right)^{20}$. Some students will be comfortable substituting the whole equation into their calculator at once, while others may become confused with brackets and exponents. You may want to suggest a strategy for inputting complex equations by starting with the "inside," and evaluating at each step. For example, do the following for the above equation:
  - Input $\frac{0.035}{4}$ and press **ENTER**.
  - Input + 1 and press **ENTER**.
  - Input ^ 20 and press **ENTER**.
  - Input $\times$ 10 000 and press **ENTER**.

  The answer from each step will automatically flow into the next step.
- If students are using different calculators, have them exchange calculators to learn how to use the keystrokes on a calculator other than their own.
- Using TI-Nspire™ CAS for **question 1c**), students can enter $A = \pi r^2 \mid r = 5$ to compute the solution. The vertical line in the command, meaning *such that*, is on a key at the bottom right of the ctrl key. The equal sign is on the bottom left of the ctrl key. Note that if the calculator's mode is set to **Auto**, then an exact answer of 25π will be returned. If the calculator's mode is set to **Approx**, then the value of 78.5398 will be returned. You can get an approximate answer in **Auto** mode by pressing ctrl enter.
- It is difficult to get a correct answer for **question 1d**) if the equation is not properly arranged. A CAS can help students with this challenge. Students can use the **Solve** command to rearrange the equation. They can press menu and select **Algebra** and then **Solve**. Input the equation $A=\pi r^2$, followed by a comma and then the letter r. Press enter. The calculator will return the rearranged equation, with r isolated, and the solutions.
- If you use a CAS to take the square root of r^2, note that a set of absolute value bars will be returned as part of the solution. You may have to help students understand what the absolute value bars mean.

- TI-Nspire™ CAS can assist with the rearrangement of the formula in **questions 3b**) and **c**).
- You can use the **Solve** command within TI-Nspire™ CAS to rearrange the formula $a^2 + b^2 = c^2$ in terms of b and c. Input it as **solve** ($a^2 + b^2 = c^2$, a), which indicates that you want the calculator to isolate the variable a. Note, however, that students may be confused by what the calculator returns. The solution is reported on one line, which is wider than the calculator screen. Students have to use the right arrow key to scroll through the rest of the line.
- If using TI-83 Plus/TI-84 Plus for **question 8**, students will have to change the window setting to see the results in a couple of the question parts. To access the window settings, press **WINDOW** and enter the following:
  - For part **b**), Xmin = 0, Xmax = 40, Xscl = 5, Ymin = 0, Ymax = 300, Yscl = 50. Then, enter the equation by pressing **Y=**, and input the expression $100(1.03)^x$ in Y1. Press **GRAPH**.
  - For part **d**), input the values Xmin = 0, Xmax = 100, Xscl = 10, Ymin = 0, Ymax = 100, Yscl = 10. Then, press **Y=** and input the expression $x(1.025)^5$ into Y1 and press **GRAPH**.
- If using TI-Nspire™ CAS for **question 8**, open a **Graphs & Geometry** page. Change the window settings by pressing (menu), selecting **Window**, and then **Window Settings**. For each part, enter the same window settings that were outlined for TI-83 Plus/TI-84 Plus. Then,
  - for part **b**), input the expression $100(1.03)^x$ in $f1(x)$ and press (enter)
  - for part **d**), input the expression $x(1.025)^5$ in $f2(x)$ and press (enter)
- Students can use TI-83 Plus/TI-84 Plus to help with **question 9**. They can enter the expression $500(1.05)^x$ into Y1, with the window settings Xmin = 0, Xmax = 30, Xscl = 5, Ymin = 0, Ymax = 2000, Yscl = 400. Press **TRACE**, input 10, and press **ENTER**. The output is the amount of the investment at 10 years. They can input 20 and press **ENTER** to find the amount of the investment at 20 years. A similar strategy can be used with TI-Nspire™ CAS.
- You may wish to revisit the steps for finding the regression equation on a graphing calculator for **question 12**.
- For **question 13**, distribute **T6–5 How to Do Section 6.4 #13 Using TI-Nspire™ CAS**.

Mathematical Process Expectations

The table shows questions that provide good opportunities for students to use the mathematical processes.

Ongoing Assessment

- Check that students understand how to rearrange a given formula in terms of a given variable.
- **Question 8** is a good question to assess whether students understand terminology and basic graphs.

Process Expectation	Selected Questions
Problem Solving	1–16
Reasoning and Proving	5, 9, 13
Reflecting	7
Selecting Tools and Computational Strategies	9, 13
Connecting	6, 8–10
Representing	6, 11
Communicating	5–9, 11, 14, 16