4.3 Model With Formulas

Strand
Modelling Linear Relations

Student Text Pages
174–183

Suggested Timing
80–160 min

Tools
- Computer Algebra System (CAS)
- graphing calculators

Related Resources
BLM 4.3.1 Practice: Model With Formulas
BLM 4.3.2 Achievement Check Rubric
BLM T2 The Computer Algebra System (CAS) on the TI-89 Calculator

Specific Expectations

Manipulating and Solving Algebraic Equations

In this section, students will

ML1.02 determine the value of a variable in the first degree, using a formula (i.e., by isolating the variable and then substituting known values; by substituting known values and then solving for the variable) (e.g., in analytic geometry, in measurement)

Link to Get Ready

This section deals with formula rearrangements. Students need to be confident with their ability to manipulate expressions using opposite operations and to work with fractions. These skills are reviewed in questions 1, 2, and 4 of the Get Ready.

Warm-Up

1. Solve each equation.
a) $3(x - 1) = 5(x - 3)$
b) $3(2 - y) = 10 + y$

2. Check the answers to 1a) and b) by substituting the solutions into the equations and checking that the left side (LS) and right side (RS) are equal.

3. Michelle solves $\frac{3}{4}x = 9$ by dividing both sides by $\frac{3}{4}$, while Lauren solves the same equation by multiplying both sides by 4 then dividing both sides by 3. Who is correct? Explain.

Warm-Up Answers

1. a) $x = 6$

b) $y = -1$

2. a) LS $= 3(x - 1)$
$= 3(6 - 1)$
$= 3(5)$
$= 15$

RS $= 5(x - 3)$
$= 5(6 - 3)$
$= 5(3)$
$= 15$

b) LS $= 3(2 - y)$
$= 3(2 - (-1))$
$= 3(3)$
$= 9$

RS $= 10 + y$
$= 10 + (-1)$
$= 9$

3. They are both correct. Michelle solved in one step: $\frac{3}{4}$ times x can be solved for x by dividing by $\frac{3}{4}$; Lauren solved in two steps, first multiplying by 4 and then dividing by 3 to solve for x.

Teaching Suggestions

Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently. Then, discuss the solutions as a class. (5–10 min)

Common Errors

- Some students may need help keeping the variables straight to effectively use the equation.

R_x Have students write out the equation along with the meaning of each variable beside the equation.

Ongoing Assessment

- While students are working on the Investigate, circulate to see how well each works within a group. This may be an opportunity to begin observing and recording the individual student's learning skills: group work, work habits, organization, and initiative.

Accommodations

Language/ESL/Perceptual—Have students copy questions into their notebooks and use coloured pencils or highlighters to highlight the relevant information in word problems.

Section Opener

- Conduct a discussion on the use of formulas and linear equations in volleyball with their use in sports in general. If time permits, have students perform an Internet search on the statistics of a sport like baseball and how formulas and linear equations are used to compile them. Have students report their findings to the class.
- Point out the definition of *formula*. Discuss as a class why formulas are powerful tools. Responses might include that the use of formulas allows easy assessment of how repeated changes in one variable affect a scenario.

Investigate

- Circulate while students complete the Investigate and provide help as needed.
- You may wish to have each student work with a partner.
- Encourage students who complete the Investigate early to assist others.
- You may wish to have students make flow diagrams to help them describe their steps in questions 2 and 3.
- This is a good section to concentrate on practical applications for equations. Students could be encouraged to search out their own examples: where cost is dependent on number, distance on speed, etc.
- Consolidate students' understanding by discussing their results.
- Use **BLM 4.3.1 Practice: Model With Formulas** for extra practice or remediation.

Investigate Answers (page 174)

1. a) 0.16 or 16%

b) 0.409 or 40.9%

2. Multiply the percentage by the total number of attacks. Then, add the number of errors. For Jade, this means a total of 5 kills.

3. Subtract errors from kills and then divide by percentage. For Merella, this means 3 total attacks.

4. a) $TA = \frac{K - E}{pct}$

b) Answers will vary. Possible answer: The steps are the same, but in question 3, we used numbers rather than variables.

Examples

- Have students work through the Examples as a class before proceeding to Discuss the Concepts. Alternatively, have students complete the Examples independently or in small groups before reviewing them as a class.
- For Example 1, you might wish to discuss as a class each step in the rearrangement. To be successful in this section, students must understand how to rearrange formulas. Some students may understand the process better if it is paralleled with a numerical example similar to ones they have already done.
- After students have completed Example 2, ask students why it might be useful to rearrange the formula before substituting. (Possible answer: Repeated substitutions can easily be made to see how changes affect the quantity of interest.)

- Have students read the MathConnect on interest rates before working through Example 3. You may wish to have them visit the web site for more information. For Example 3, some students may ask which is the better method to use. Lead a discussion on the ease of manipulating a formula with variables versus manipulating with values. Students should realize that they may choose the method that they feel more comfortable with because both methods involve the same steps, but in slightly different order.
- For Example 4, the Method 2 CAS solution can only be done if a CAS is available. If one is not available, have students focus on the paper-and-pencil solution. You may wish to use **BLM T2 The Computer Algebra System (CAS) on the TI-89 Calculator** for this activity.

Key Concepts

- Remind students of the methods for solving problems that they have just worked on.
- Refer students to the MathConnect from Example 3 and how banks use formulas to calculate interest. This is an excellent lead-in to questions 3, 4, and 5 of Practise the Concepts.

Discuss the Concepts

- Some students might benefit from a review of opposite operations before working on these questions.
- Give the class time to formulate answers before conducting a discussion.
- Note to students that the formula for D1a) should be $d = \frac{V}{at}$.

Discuss the Concepts Suggested Answers (page 180)

D1. a) Divide both sides by V.

b) Divide both sides by c^2.

c) Multiply by t, subtract w, and then divide by -10.

D2. They are both correct. Mina substituted first, then rearranged, while Francesco rearranged the formula first, then substituted. They will both get the same result.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.

Apply the Concepts (B)

- For questions 7 and 8, some students may need a review of the distance, speed, and time relationship, $d = st$.
- For question 10, have students refer back to the Discuss the Concepts, question D1 c).
- Question 14 is a Chapter Problem. Remind students to keep the solution to this question handy as the methods they used may help them with the Chapter Problem Wrap-Up.
- Question 15 is an Achievement Check. It can be used as a form of diagnostic or formative assessment, or assigned as a small summative assessment piece. This provides an opportunity for formative or self-assessment, using **BLM 4.3.2 Achievement Check Rubric**.

Achievement Check (page 183)

15. a) $y = -0.006x + 10$

or

$T = -0.006A + 10$

b) $A = ?\ T = -10°C$

Substitute $T = -10°C$ into the equation,

$-10 = -0.006A + 10$

$A = 3333.3$

Therefore, they are 3333.3 m up the mountain.

c) $7.5 \text{ km} \times \frac{1000 \text{ m}}{1 \text{ km}} = 7500 \text{ m}$

Substitute $A = 7500$ into the equation,

$T = -0.006\ (7500) + 10$

$= -35$

Therefore, the temperature outside the plane is 35°C.

Extend the Concepts (C)

- Assign the Extend the Concepts questions to students who are not being challenged by questions in Apply the Concepts.
- Extend the Concepts questions can be used as a diagnostic assessment for those students considering a university-level course in grade 11.
- You may wish to have students working on question 16 try to get statistics from the school baseball team to calculate the WHIP for the pitchers on the team.