EXPLORATIONS

Activity 3

Number Crunching! Number Munching!

Teacher Notes

Concepts

- Order of operations
- Simplifying numerical expressions
- Evaluating variable expressions
- Solving problems using variables

Calculator Skills

- Using [+], [−], [×], [÷], and [(−)]
- Using parentheses and division as grouping symbols
- Observing the order of operations used by the calculator
- Storing data as variable names: [STO▶]
- Using variables in evaluating expressions: [MEMVAR]

Materials

- TI-30X IIS
- Student Activity pages (p. 28-30)

Objective

- Students will learn the order of operations and how to simplify expressions using the power of the calculator. They also will learn how to solve problems using the calculator as a tool for evaluating expressions.

Topics Covered

- Representing problems that involve variable quantities with expressions
- Using math operations on expressions and solve problems
- Appreciating the power of mathematical notation and its role in developing mathematical ideas

Introduction

Julie invited six of her friends from algebra class to her home to study for an examination. They had 3 pizzas delivered at a cost of $7.95 per pizza, plus 8.25% tax and a $4.00 tip for the driver. Can you write an expression that will show the amount to be paid if the cost is to be shared equally among the seven young people? How much money will each person have to pay?

Investigation

Note: Most of the exercises in this activity can be performed using a combination of mental mathematics, paper-and-pencil calculations. Students should be encouraged to use these methods. The power of the calculator should be used to show "how" algebraic operations and properties work. The TI-30X IIS calculator has a special two-line display that is a powerful feature to enable student understanding of key concepts in the development of the idea of "variable."

Before you explore the pizza problem, demonstrate these steps to the class.

1. Press the following keys on your overhead calculator:

   32 ÷ 8 − 4=

   Which operation did the calculator do first?

   The calculator divided 32 by 8 to get 4. Then 4 minus 4 is 0.

2. Add parentheses to the expression to get the following:

   32 ÷ (8 − 4) =

   On the calculator, use the editing keys to edit the previous expression.

   ▲ ▶ ▶ ▶ 2nd [INS] (▶ ▶ ▶) ENTER

   Which operation did the calculator do first this time?

   The calculator subtracted 4 from 8.

   When you simplify expressions, you use the order of operations, just like the calculator!

3. Discuss the order of operations:

   a. Do all work inside the parentheses.

   b. Do all multiplication and division in order from left to right.

   c. Do all additions and subtractions in order from left to right.

4. Write an expression to solve the pizza problem. Have the students work in small groups to determine an expression to solve the problem.

   The expression should be one like this:

   $$\frac{(3 * 7.95)(108.25\%) + 4.00}{7}$$

5. Evaluate this expression on the calculator:

   ((*3* × *7.95*) (*108.2 5* 2nd [%]) + *4.00*) ÷ *7* ENTER

   The result should be: 4.259660714 (Note: You may want to review the use of [FIX] 2 to see that the calculator will round to two decimal places.)

   Each person will contribute $4.26 to pay for the pizza.

6. Explain that in later work in algebra, you will need to know how to store values for variables in the calculator, and use these variables to solve problems.
7. Let a = 3, b = 5, and c = 7 and store these values in the calculator.

Press:	The calculator shows:
CLEAR 3 STO▸	→ A B C D E DEG
ENTER	3→A 3 DEG
5 STO▸ ▷	→ A B C D E DEG
ENTER	5→A 5 DEG
7 STO▸ ▷ ▷ ENTER	7→A 7 DEG

8. Evaluate the expression A(2B – C) using the values stored in the variables.

Press:	The calculator shows:
CLEAR MEMVAR	A B C D E 3 DEG (The variable A has a value of 3.)
ENTER	A DEG
(2 MEMVAR ▷ ENTER	A (2B DEG
– MEMVAR ▷ ▷ ENTER)	A (2B - C) 9 DEG
ENTER	

Wrap-Up

- Have the students complete Student Activity.
- Give students the information from a food package that shows the fat, protein, and carbohydrate content of the food. There are four calories in each gram of protein and in each gram of carbohydrates and there are nine calories in each gram of fat. Have the students write a variable expression and evaluate the expression to find the number of calories in the food.

Extensions

- Use the values that you stored in variables A, B, and C earlier in this activity. Work in pairs to write at least two different variable expressions with the three variables that equals zero.
- Use your calculator to show why $(a - b)^2$ does not always equal $a^2 - b^2$.

Solutions

Use an appropriate method to simplify each expression. If you choose to use the calculator, write the keystrokes used and what the calculator does in each of the parts (a) and (b). If you do these mentally, describe your processes in word form for each part (a) and (b).

1. (a) 12 ÷ 4 − 2 *1*

   (b) 12 ÷ (4 − 2) *6*

2. (a) 6 − 2 x 3 *0*

   (b) (6 − 2) x 3 *12*

3. (a) 5 x 8 + 2 *42*

   (b) 2 + 5 x 8 *42*

4. (a) 9 x 6 − 4 x 4 *38*

   (b) 9 x (6 − 4) x 2 *36*

5. (a) 7 + 9 ÷ 2 *11.5*

   (b) (7 + 9) ÷ 2 *8*

6. (a) 24 − 3(7 − 5) *18*

   (b) (24 − 3)(7 − 5) *42*

7. Use the calculator to simplify the expression 15 + 9 ÷ 3 − 2.

   16

(a.) Add parentheses to the expression so that it equals 6 when simplified.

(15 + 9) ÷ 3 – 2

(b.) Add parentheses to the expression so that it equals 16 when simplified.

15 + (9 ÷ 3 – 2) or 15 + (9 ÷ 3) – 2

Simplify each of these expressions using an appropriate method. Describe how you would use your calculator to simplify each one.

8. $7(8 - 3.5) - 12$ *19.5*

9. $28 \div 7 + 4.2 \div 6$ *4.7*

10. $0.90(8 + 8 \times 0.05)$ *7.56*

11. $25 + 85 \div 100 + 7$ *32.85*

12. $5 \div 25 + 3(5)$ *15.2*

13. $\frac{7(13)}{9(4)}$ *2.5277*

14. $(7 - 4) \div (4 + 7)$ *0.272727*

15. $\frac{9(9)+7}{5}$ *17.6*

16. $\frac{38-14}{6} + 3(20)$ *64*

17. $\frac{37.25 - 3 \cdot 5}{9+6}$ *1.4833333*

18. $2\left(3 \cdot 12 - \frac{15}{16}\right)$ *70.125*

19. $\frac{(7+5)(8-3)}{(3+5)}$ *7.5*

20. Add parentheses to the expression $5 - 4 \times 3 \div 2 + 1$ so that it equals 1 when simplified.

(5 – 4) x 3 ÷ (2 + 1)

21. Juanelle works as a waitress at a restaurant. Suppose that she makes $6.50 per hour and that she earns, on average, 15% in tips from all her table orders. If Juanelle worked for 7 hours on Friday night and had orders that totaled $523.35 and then worked 5 hours on Saturday night with orders which totaled $487.65, write an expression that will represent how much money Juanelle will earn (before taxes) for the two nights' work.

    7 x ·6.50 + .15 x 523.35 + 5 x 6.50 + .15 x 487.65

    or 6.50(7 + 5) + .15(523.35 + 487.65)

    Now evaluate this expression with your calculator.

    $229.65

Use the calculator to store the values A = 5, B = 12, and C = 6, and then evaluate each expression.

22. $A^2 + B^2$ *169*

23. $6C - B$ *24*

24. $\frac{5B}{3C - 5A}$ *-8.571428571*

25. $\frac{5A + 2B}{C}$ *8.166666667*

26. $\sqrt{C^2 - A^2}$ *3.31662479*

27. $\frac{6B - 2A}{3C + A}$ *2.695652174*

28. $B^2 + C^2 - 2BC$ *36*

29. Explain the difference between simplifying a numerical expression and evaluating a variable expression.

    Simplifying a numerical expression requires the use of the order of operations to arrive at a result. Evaluating an expression means that you must first substitute values for the variables and then use order of operations to arrive at the result.

    Give examples of each. *(Answers will vary)*

30. In some cities, salt is used to melt ice on the streets in winter. A solution that is 30% salt and 70% water freezes at -21° C. Use the conversion formula given below to find the Fahrenheit temperature at which this mixture freezes.

    $F = \frac{9}{5}C + 32$ where F equals the temperature in degrees Fahrenheit and C equals the temperature in degrees Centigrade.

    -5.8 degrees Fahrenheit

Student Activity 3

Name _____

Date _____

Developing the Concept of a Variable — Number Crunching! Number Munching!

Objective: *You will learn the order of operations and how to simplify expressions using the power of the calculator. You also will learn how to solve problems using the calculator as a tool for evaluating expression.*

Use an appropriate method to simplify each expression. If you choose to use the calculator, write the keystrokes used and what the calculator does in each of the parts (a) and (b). If you do these mentally, describe your processes in word form for each part (a) and (b).

1. (a) $12 \div 4 - 2$

   (b) $12 \div (4 - 2)$

2. (a) $6 - 2 \times 3$

   (b) $(6 - 2) \times 3$

3. (a) $5 \times 8 + 2$

   (b) $2 + 5 \times 8$

4. (a) $9 \times 6 - 4 \times 4$

   (b) $9 \times (6 - 4) \times 2$

5. (a) $7 + 9 \div 2$

   (b) $(7 + 9) \div 2$

6. (a) $24 - 3(7 - 5)$

   (b) $(24 - 3)(7 - 5)$

7. Use the calculator to simplify the expression $15 + 9 \div 3 - 2$.

   (a.) Add parentheses to the expression so that it equals 6 when simplified.

   (b.) Add parentheses to the expression so that it equals 16 when simplified.

Simplify each of these expressions using an appropriate method. Describe how you would use your calculator to simplify each one.

8. $7(8 - 3.5) - 12$

9. $28 \div 7 + 4.2 \div 6$

10. $0.90(8 + 8 \times 0.05)$

11. $25 + 85 \div 100 + 7$

12. $5 \div 25 + 3(5)$

13. $\frac{7(13)}{9(4)}$

14. $(7 - 4) \div (4 + 7)$

15. $\frac{9(9)+7}{5}$

16. $\frac{38-14}{6} + 3(20)$

17. $\frac{37.25 - 3 \cdot 5}{9+6}$

18. $2\left(3 \times 12 - \frac{15}{16}\right)$

19. $\frac{(7+5)(8-3)}{(3+5)}$

20. Add parentheses to the expression $5 - 4 \times 3 \div 2 + 1$ so that it equals 1 when simplified.

21. Juanelle works as a waitress at a restaurant. Suppose that she makes $6.50 per hour and that she earns, on average, 15% in tips from all her table orders. If Juanelle worked for 7 hours on Friday night and had orders that totaled $523.35 and then worked 5 hours on Saturday night with orders which totaled $487.65, write an expression that will represent how much money Juanelle will earn (before taxes) for the two nights' work.

    Now evaluate this expression with your calculator.

Use the calculator to store the values A = 5, B = 12, and C = 6, and then evaluate each expression.

22. $A^2 + B^2$

23. $6C - B$

24. $\dfrac{5B}{3C - 5A}$

25. $\dfrac{5A + 2B}{C}$

26. $\sqrt{C^2 - A^2}$

27. $\dfrac{6B - 2A}{3C + A}$

28. $B^2 + C^2 - 2BC$

29. Explain the difference between simplifying a numerical expression and evaluating a variable expression.

    Give examples of each.

30. In some cities, salt is used to melt ice on streets in winter. A solution that is 30% salt and 70% water freezes at –21° C. Use the conversion formula given below to find the Fahrenheit temperature at which this mixture freezes.

    $F = \dfrac{9}{5}C + 32$ where F equals the temperature in degrees Fahrenheit and C equals the temperature in degrees Centigrade.