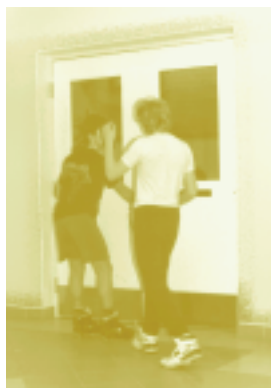## Activity 2: Solving Problems Involving Multiple Operations

Read over the following list of activities.

- Get dressed.
- Have breakfast.
- Shower.
- Go to class.
- Get out of bed.
- Catch the bus for school.
- Brush your teeth.

In what order would you put these activities? Why is order so important in this case?

In this activity you will solve rational number problems involving more than one operation with a calculator. You will also discover why it is important to perform arithmetic operations in a particular order.

Suppose you have the following calculation.
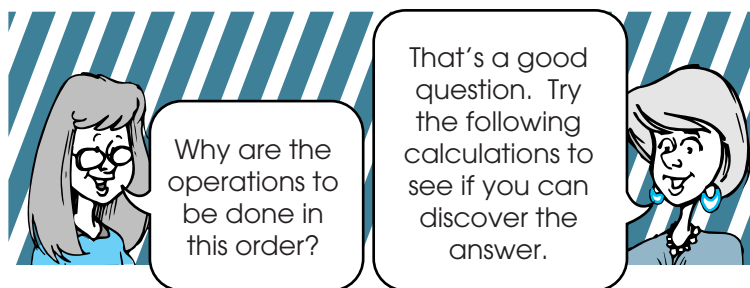
$$(24.75 + 18.98 - 1.49) \times 1.07$$

This question involves the operations of addition, subtraction, and multiplication. How do you know which operation to do first?

Order of Operations

Do you recall the acronym BEDMAS? The letters stand for various operations and are to be done in the order given.

B—**b**rackets
E—**e**xponents
D—**d**ivision or
M—**m**ultiplication
A—**a**ddition or
S—**s**ubtraction

1. Write out, in words, how the order of operations are to be done according to BEDMAS.

Why are the operations to be done in this order?

That's a good question. Try the following calculations to see if you can discover the answer.

2. **a.** $0.50 - 0.70 \times 0.30$ **b.** $(0.50 - 0.70) \times 0.30$

3. In question 2.a., which operation did the calculator do first?

4. What effect did the brackets have on the calculator in question 2.b.?

5. Are the answers to questions 2.a. and 2.b. the same? Explain.

Check your answers by turning to the Appendix.

Now study the following examples which illustrate the various operations performed with a calculator.

Example 1

Calculate $(24.75 + 18.98 - 1.49) \times 1.07$.

Solution

Estimate

$$(24.75 + 18.98 - 1.49) \times 1.07 \doteq (25 + 19 - 1) \times 1 \quad \longleftarrow \text{Perform the operations in the brackets.}$$
$$\doteq (43) \times 1 \quad \longleftarrow \text{Multiply.}$$
$$\doteq 43$$

Calculator

(2 4 · 7 5 **+** 1 8 · 9 8

− 1 · 4 9) **×** 1 · 0 7 **=**

$$\boxed{45.1968}$$

Example 2

Calculate $4 + (-12) \div (-15)$.

Solution

Estimate

$$4 + (-12) \div (-15) = 4 + \left(\frac{-12}{-15} \right) \quad \longleftarrow \text{Divide.}$$
$$\doteq 4 + 1 \quad \longleftarrow \text{Add.}$$
$$\doteq 5$$

Calculator

4 **+** 1 2 +/− **÷** 1 5 +/− **=**

$$\boxed{4.8}$$

Notice that brackets are not required to have the calculator do multiplication before addition or to have a negative sign attached to a number. Most calculators automatically do multiplication and division before addition and subtraction.

Perform the following calculations using a calculator. Follow the rules associated with the acronym BEDMAS. Be sure to estimate before you use your calculator.

6.　**a.**　$5.27 + 9.3 \times 2.1$　　　　**b.**　$-3.98 \times 1.4 \div 0.7 + 7.56$

　　c.　$(3.34 - 7.21)4 - 3.50$　　**d.**　$\dfrac{5.3 + 25.1 - 19.3}{4}$

7.　Why were the brackets used in the calculator answer to question 6.d.?

8.　In question 6.d., what other keystroke could you use in place of the brackets in order to obtain the same answer? Is this a better way to perform the calculations? Explain.

9.　Estimate the total cost for the following before taxes.

　　a.　2 CD's @ $11.99 each and 1 audiotape @ $7.99

　　b.　3 pairs of socks @ $2.89/pair and 2 pairs of jeans @ $34.98/pair

　　c.　6 cans of peas @ 3 for $1.89

Check your answers by turning to the Appendix.

A calculator can be used to help solve problems involving several operations that must be performed in a specified order. The following examples illustrate order of operations with the use of a calculator in problem solving.

Example 3

Have you ever looked out over the ocean? The distance you can see out over the ocean, when standing on the shore, is given by the formula $d = 3.6\sqrt{h}$, where d is the distance (in kilometres) and h is the height of your eyes above the water (in metres).

Find the distance you can see if your eyes are 2.5 m above the water. Round your answer to the nearest tenth.
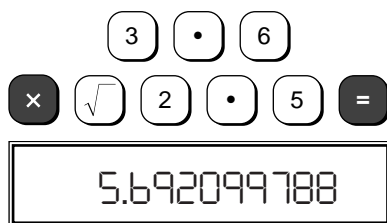
Solution

Substitute into the formula.

$$d = 3.6\sqrt{h}$$
$$= 3.6\sqrt{2.5}$$

Enter the following keystrokes.

$$\boxed{3}\ \boxed{\cdot}\ \boxed{6}$$

$$\boxed{\times}\ \boxed{\sqrt{}}\ \boxed{2}\ \boxed{\cdot}\ \boxed{5}\ \boxed{=}$$

$$\boxed{5.692099788}$$

The calculator finds the square root first; then it multiplies.

Therefore, you can see approximately 5.7 km out over the ocean.

Example 4

A department store had cameras on sale for 15% off the regular price. One type of camera was still not selling well; so it was discounted a further 10%. Find the sale price of this camera if it was regularly priced at $425. Find the total cost after 7% GST is added.
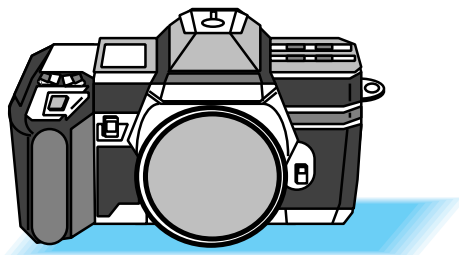
Solution

Estimate the sales price.

$$\big[\,425 - (425 \times 15\%)\,\big] - \big\{\big[\,425 - (425 \times 15\%)\,\big] \times 10\%\big\}$$
$$= \big[\,400 - (400 \times 0.15)\,\big] - \big\{\big[\,400 - (400 \times 0.15)\,\big] \times 0.10\big\}$$
$$\doteq (400 - 60) - (400 - 60) \times 0.10$$
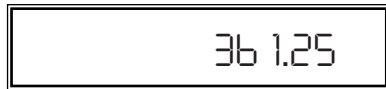$$\doteq 340 - (340 \times 0.10)$$
$$\doteq 340 - 34$$
$$\doteq 306$$
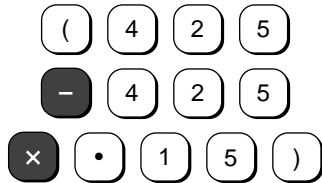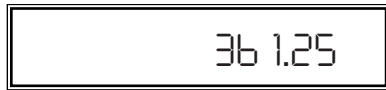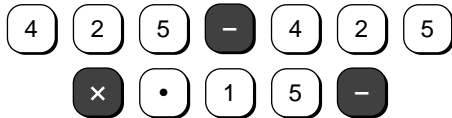
The sale price is approximately $306.

Estimate the sale price including GST.

$$306 + 306 \times 7\% \doteq 300 + 300 \times 0.07$$
$$\doteq 300 + 21$$
$$\doteq 321$$

The sale price including GST is approximately $321.

Enter the following keystrokes to determine the sale price.

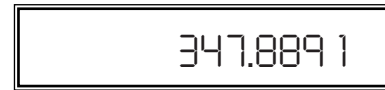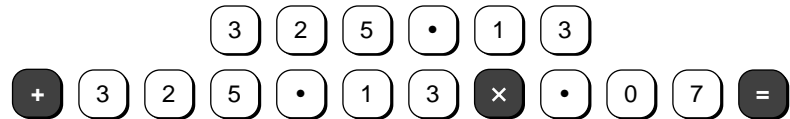$$\boxed{4}\ \boxed{2}\ \boxed{5}\ \boxed{-}\ \boxed{4}\ \boxed{2}\ \boxed{5} \qquad 15\% = 0.15$$

$$\boxed{\times}\ \boxed{\cdot}\ \boxed{1}\ \boxed{5}\ \boxed{-}$$

$$\boxed{36\ 1.25}$$

$$\boxed{(}\ \boxed{4}\ \boxed{2}\ \boxed{5}$$

$$\boxed{-}\ \boxed{4}\ \boxed{2}\ \boxed{5}$$

$$\boxed{\times}\ \boxed{\cdot}\ \boxed{1}\ \boxed{5}\ \boxed{)}$$
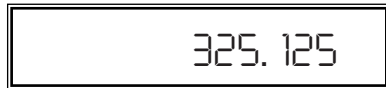
$$\boxed{36\ 1.25}$$

Notice only one set of brackets was required to do this calculation on a scientific calculator.

$$\boxed{\times}\ \boxed{\cdot}\ \boxed{1}\ \boxed{=}$$

$$\boxed{325.\ 125}$$

The camera is on sale for $325.13.

Find the total cost including GST.

$$325.13 + 325.13 \times 0.07$$

Enter the following keystrokes.

$$\boxed{3}\ \boxed{2}\ \boxed{5}\ \boxed{\cdot}\ \boxed{1}\ \boxed{3}$$

$$\boxed{+}\ \boxed{3}\ \boxed{2}\ \boxed{5}\ \boxed{\cdot}\ \boxed{1}\ \boxed{3}\ \boxed{\times}\ \boxed{\cdot}\ \boxed{0}\ \boxed{7}\ \boxed{=}$$

$$\boxed{347.889\ 1}$$

The total cost of the camera is $347.89.

Many problems in science, business, and economics involve performing several operations in the proper order. Solve the following problems using a scientific calculator.

10. Samantha bought a new bicycle that cost $375 before tax. If the GST is 7% and the PST is 5%, how much did Samantha have to pay altogether?

11. The Van Dusen family purchased a new house in Edmonton for $135 000. Two years later, they sold it to the O'Rourkes for 5% more than they paid for it (not including GST). Six months later, Mr. O'Rourke got transferred and they ended up selling the house for 5% less than their purchase price. Ignore all additional charges such as legal fees and document fees.

    a. How much did the Van Dusen family pay including GST?

    b. How much did the O'Rourkes pay for the house?
    Note: GST is paid on new houses only.

    c. What did the O'Rourkes sell the house for?

12. Matthew is collecting quarters and dimes. The face value of his collection is given by the following equation.

$$v = 0.25q + 0.1d$$

What is the face value of his collection if he has 31 quarters and 82 dimes?

The formula for the time it takes any object to fall from a given height is $t = \sqrt{\frac{h}{4.9}}$ where t is time (in seconds) and h is height (in metres). Use this formula to answer questions 13 to 15.

13. The distance from the top of the High Level Bridge in Edmonton to the riverbed is 41.8 m. If the North Saskatchewan River is presently flowing at a depth of 2.1 m, how long would it take a stone to reach the water if it were dropped from the top of the bridge? (Round your answer to one decimal place.)

14. The apex of the largest pyramid at the Muttart Conservatory in Edmonton is 24.1 m above the ground. Suppose a drop of water inside this pyramid falls from the apex directly to the ground. How long would it take the drop of water to reach the ground? (Round your answer to one decimal place.)

15. It was Galileo who first showed that the mass of an object does not affect the speed at which it falls. It is believed he did this by dropping two objects of different masses from the Leaning Tower of Pisa in Italy. The two objects hit the ground at the same time. How long did it take for the two objects to reach the ground if the distance the objects fell was 54.5 m? (Round your answer to one decimal place.)

THEO VAN BOXEL

Check your answers by turning to the Appendix.

You may wish to look for information about the Leaning Tower of Pisa on the Internet. Type in the words "leaning tower of pisa" on any of the search engines on the Internet. You may find a wealth of information as well as a number of photographs.

Now Try This

Use one of the problem-solving strategies to solve the following:

Use a calculator to answer question 16.

16. Find each of the following square roots.

    a. $\sqrt{4}$ **b.** $\sqrt{40}$

    c. $\sqrt{400}$ **d.** $\sqrt{4000}$

    e. $\sqrt{40\,000}$ **f.** $\sqrt{400\,000}$

17. Look at your answers to question 16. Can you see a pattern? Explain.

18. Use the conclusions you reached in question 17 to help you answer the following. **Do not** do any calculations.

    a. If $\sqrt{16} = 4$, then $\sqrt{160\,000} = \boxed{}$.

    b. If $\sqrt{39} \doteq 6.245$, then $\sqrt{3900} \doteq \boxed{}$.

    c. If $\sqrt{225} = 15$, then $\sqrt{2.25} = \boxed{}$.

    d. If $\sqrt{7.5} \doteq 2.7386$, then $\sqrt{750} \doteq \boxed{}$.

    e. If $\sqrt{25} = 5$, then $\sqrt{25\,000\,000} = \boxed{}$.

Check your answers by turning to the Appendix.

In this activity you solved problems involving several operations using a calculator and you saw why the order of these operations is important.