Chapter 3
Lesson 9

Order of Operations

You will need
- a calculator

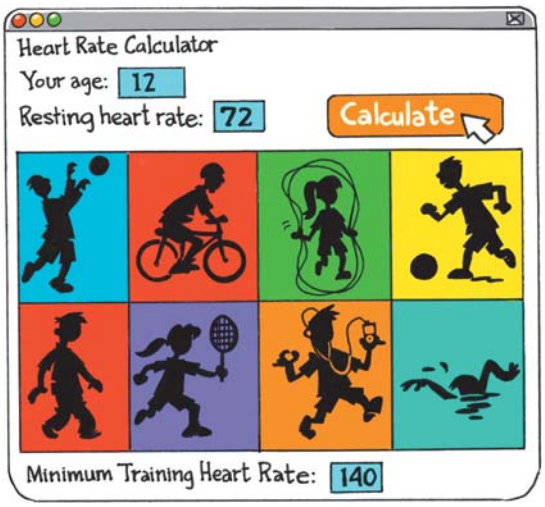
GOAL

Apply the rules for order of operations with whole numbers.

Oleh found this formula online for calculating his minimum training heart rate:

Minimum training heart rate
= (220 − age + resting heart rate) ÷ 2

Oleh entered his age of 12 and his resting heart rate of 72 beats each minute. The online calculator gave an answer of 140 beats each minute.



How can Oleh check the calculator's answer?

Oleh's Solution

I'll use the values of 12 for age and 72 for resting heart rate in the formula. I'll use the **rules for order of operations** to calculate my minimum training heart rate.

Minimum training heart rate = (220 − 12 + 72) ÷ 2
= (208 + 72) ÷ 2
= (280) ÷ 2
= 140

rules for order of operations

A set of rules that are used when calculating so the answer is always the same:

- Do the operations in brackets first.
- Next, divide and multiply from left to right.
- Finally, add and subtract from left to right.

I did the operations in the brackets first, in the order they were written.
Then I divided the answer in the brackets by 2.
My training rate should be 140 beats each minute.
The answer given by the online calculator is correct.

Reflecting

A. How would Oleh's answer change if he ignored the brackets in the formula?

B. Did it matter which operation in the brackets Oleh did first? Explain.

Checking

1. Elena is writing a report about the effects of smoking on lung health. She found the following formula for calculating approximate lung capacity:

Lung capacity (millilitres)
$= 41 \times$ height in centimetres $- 18 \times$ age in years $- 2690$

a) Calculate the approximate lung capacity of a 30-year-old man whose height is 180 cm. Show your work.

b) How do you know that your answer is reasonable?

Communication Tip

Brackets can be many different shapes, such as [ ], { }, and ( ). Curved brackets, ( ), are sometimes called parentheses. Some calculators have brackets you can enter when performing a calculation, such as (and).

Practising

2. Calculate.

a) $15 + 8 \times 8$

b) $16 - 3 \times 5 + 20$

c) $6 \times 7 + (12 + 9) \div 3$

d) $16 \div 4 - 8 \div 2$

e) $(12 + 8) \div 2 + 7$

f) $3 + 2 \times 3 \times 5 - 1$

3. a) Use the formula in Question 1 to calculate your own approximate lung capacity. Show your work.

b) Where would you place brackets to make sure that the operations in the formula are done in the correct order?

c) How can you test whether your calculator follows the rules for order of operations?

4. **a)** $47 - (4 \times 4 \times 5) \div 2$

b) $(18 \div 2 + 1) \times 4 + 2 \times 5$

5. Each expression has four 4s and is equal to 1.

$4 + 4 \div 4 - 4$ $\quad$ $(4 + 4) \div (4 + 4)$ $\quad$ $44 \div 44$

a) Show that each expression equals 1.

b) Make new expressions that equal each whole number from 2 to 5.

- You must use four 4s in each expression.
- You may combine digits to form a two-digit number such as 44.
- You may use any operation plus brackets.

6. Is each calculation correct? If not, correct the answer.

a) $12 \times 9 + 3 = 111$

b) $5 \times 5 + 5 - 4 \div 2 = 13$

c) $4 \times 5 + 4 \times 4 + 4 \times 3 = 48$

d) $30 - 2 \times (10 - 2) = 8$

7. Calculate. Will the answer be the same if you remove the brackets? Explain your reasoning.

a) $(3 \times 5) \times 5$

b) $4 + (3 \times 5) \times 3$

c) $(4 \times 4 \times 3) \div 2 + 1$

d) $100 \div (10 + 10) \times 3$

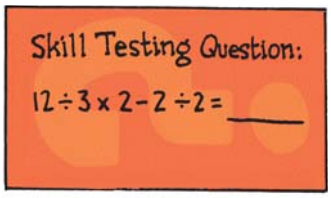
8. What are the missing operation signs that will make each statement true? Use brackets if necessary.

a) $12 \square 3 \square 2 = 18$

b) $4 \square 2 + 4 \square 2 = 16$

c) $20 \square 4 \square 2 = 12$

d) $100 \square 100 \square 200 = 0$



9. The winner of a cereal-box contest usually has to answer a skill-testing question.

a) Give an example of a calculation that someone could answer correctly without knowing the rules for order of operations.

b) Give an example of a calculation that someone could *not* answer correctly without knowing the rules for order of operations.