2.3 Skill Builder

Adding Integers

To add a positive integer and a negative integer: $7 + (-4)$

- Model each integer with tiles.
- Circle zero pairs.

7: ▢▢▢▢▢▢▢
−4: ■■■■

There are 4 zero pairs.
There are 3 ▢ tiles left.
They model 3.
So, $7 + (-4) = 3$

Each pair of 1 ■ tile and 1 ▢ tile makes a zero pair. The pair models 0.

To add 2 negative integers: $(-4) + (-2)$

- Model each integer with tiles.
- Combine the tiles.

−4: ■■■■
−2: ■■

There are 6 ■ tiles.
They model -6.
So, $(-4) + (-2) = -6$

Check

1. Add.

a) $(-3) + (-4) =$ _____

b) $6 + (-2) =$ _____

c) $(-5) + 2 =$ _____

d) $(-4) + (-4) =$ _____

2. a) Kerry borrows \$5. Then she borrows another \$5.
Add to show what Kerry owes.
$(-5) + (-5) =$ _____
Kerry owes \$_____.

When an amount of money is negative, it is owed.

b) The temperature was 8°C. It fell 10°C.
Add to show the new temperature.
$8 +$ (_____) = _____
The new temperature is _____°C.

Subtracting Integers

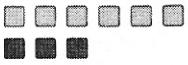
To subtract 2 integers: $3 - 6$

- Model the first integer.
- Take away the number of tiles equal to the second integer.

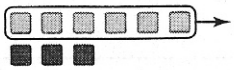
Model 3.

Adding zero pairs does not change the value. Zero pairs represent 0.

There are not enough tiles to take away 6.
To take away 6, we need 3 more □ tiles.
We add zero pairs. Add 3 □ tiles and 3 ■ tiles.



Now take away the 6 □ tiles.



Since 3 ■ tiles remain, we write: $3 - 6 = -3$

When tiles are not available, think of subtraction as the opposite of addition.
To subtract an integer, add its opposite integer.
For example,

$(-3) - (+2) = -5$

Subtract $+2$.

$(-3) + (-2) = -5$

Add -2.

Check

1. Subtract.

a) $(-6) - 2 =$ _____

b) $2 - (-6) =$ _____

c) $(-8) - 9 =$ _____

d) $8 - (-9) =$ _____

Dividing Integers

When dividing 2 integers, look at the sign of each integer:

- When the integers have the same sign, their quotient is positive.
- When the integers have different signs, their quotient is negative.

The same rule applies to the multiplication of integers.

$6 \div (-3)$ These 2 integers have different signs, so their quotient is negative.
$6 \div (-3) = -2$

$(-10) \div (-2)$ These 2 integers have the same sign, so their quotient is positive.
$(-10) \div (-2) = 5$

Check

1. Calculate.

a) $(-4) \div 2$
$=$ _____

b) $(-6) \div (-3)$
$=$ _____

c) $15 \div (-3)$
$=$ _____

2.3 Order of Operations with Powers

FOCUS **Explain and apply the order of operations with exponents.**

We use this order of operations when evaluating an expression with powers:

- Do the operations in brackets first.
- Evaluate the powers.
- Multiply and divide, in order, from left to right.
- Add and subtract, in order, from left to right.

We can use the word BEDMAS to help us remember the order of operations:

B **B**rackets
E **E**xponents
D **D**ivision
M **M**ultiplication
A **A**ddition
S **S**ubtraction

Example 1 Adding and Subtracting with Powers

Evaluate.

a) $2^3 + 1$ **b)** $8 - 3^2$ **c)** $(3 - 1)^3$

Solution

a) $2^3 + 1$ — Evaluate the power first: 2^3
$= (2)(2)(2) + 1$ — Multiply: $(2)(2)(2)$
$= 8 + 1$ — Then add: $8 + 1$
$= 9$

b) $8 - 3^2$ — Evaluate the power first: 3^2
$= 8 - (3)(3)$ — Multiply: $(3)(3)$
$= 8 - 9$ — Then subtract: $8 - 9$
$= -1$

To subtract, add the opposite: 8 + (−9)

c) $(3 - 1)^3$ — Subtract inside the brackets first: $3 - 1$
$= 2^3$ — Evaluate the power: 2^3
$= (2)(2)(2)$ — Multiply: $(2)(2)(2)$
$= 8$

Check

1. Evaluate.

a) $4^2 + 3 = \_\_\_\_\_ + 3$

$= \_\_\_\_\_$

$= \_\_\_\_\_$

b) $5^2 - 2^2 = \_\_\_\_\_ - (2)(2)$

$= \_\_\_\_\_$

$= \_\_\_\_\_$

c) $(2 + 1)^2 = \_\_\_\_\_^2$

$= \_\_\_\_\_$

$= \_\_\_\_\_$

d) $(5 - 6)^2 = \_\_\_\_\_$

$= \_\_\_\_\_$

$= \_\_\_\_\_$

Example 2 Multiplying and Dividing with Powers

Evaluate.

a) $[2 \times (-2)^3]^2$

Curved brackets Square brackets

b) $(7^2 + 5^0) \div (-5)^1$

When we need curved brackets for integers, we use square brackets to show the order of operations.

Solution

a) $[2 \times (-2)^3]^2$
$= [2 \times (-8)]^2$
$= (-16)^2$
$= 256$

Evaluate what is inside the square brackets first: $2 \times (-2)^3$
Start with $(-2)^3 = -8$.

b) $(7^2 + 5^0) \div (-5)^1$
$= (49 + 1) \div (-5)^1$
$= 50 \div (-5)^1$
$= 50 \div (-5)$
$= -10$

Evaluate what is inside the brackets first: $7^2 + 5^0$
Add inside the brackets: $49 + 1$
Evaluate the power: $(-5)^1$

Check

1. Evaluate.

a) $5 \times 3^2 = 5 \times$ ____ ____
$= 5 \times$ ____
$=$ ____

b) $8^2 \div 4 =$ ____ ____ $\div 4$
$=$ ____ $\div 4$
$=$ ____

c) $(3^2 + 6^0)^2 \div 2^1$
$= ($____ $+$ ____$)^2 \div 2^1$
$=$ ____ $\div 2^1$
$=$ ____ $\div$ ____
$=$ ____

d) $10^2 + (2 \times 2^2)^2 = 10^2 + (2 \times$ ____$)^2$
$= 10^2 +$ ____
$=$ ____ $+$ ____
$=$ ____

Example 3 Solving Problems Using Powers

Corin answered the following skill-testing question to win free movie tickets:
$120 + 20^3 \div 10^3 + 12 \times 120$
His answer was 1568.
Did Corin win the movie tickets? Show your work.

Solution

$120 + 20^3 \div 10^3 + 12 \times 120$
$= 120 + 8000 \div 1000 + 12 \times 120$
$= 120 + 8 + 1440$
$= 1568$

Corin won the movie tickets.

Evaluate the powers first: 20^3 and 10^3
Divide and multiply.
Add: $120 + 8 + 1440$

Check

1. Answer the following skill-testing question to enter a draw for a Caribbean cruise.

$(6 + 4) + 3^2 \times 10 - 10^2 \div 4$
$=$ _____
$=$ _____
$=$ _____

Practice

1. Evaluate.

a) $2^2 + 1 = \_\_\_\_ + 1$
$= \_\_\_\_ + 1$
$= \_\_\_\_$

b) $2^2 - 1 = \_\_\_\_ - 1$
$= \_\_\_\_ - 1$
$= \_\_\_\_$

c) $(2 + 1)^2 = \_\_\_\_$
$= \_\_\_\_$
$= \_\_\_\_$

d) $(2 - 1)^2 = \_\_\_\_$
$= \_\_\_\_$
$= \_\_\_\_$

2. Evaluate.

a) $4 \times 2^2 = 4 \times \_\_\_\_$
$= 4 \times \_\_\_\_$
$= \_\_\_\_$

b) $4^2 \times 2 = \_\_\_\_ \times 2$
$= \_\_\_\_ \times 2$
$= \_\_\_\_$

c) $(4 \times 2)^2 = \_\_\_\_$
$= \_\_\_\_$
$= \_\_\_\_$

d) $(-4)^2 \div 2 = \_\_\_\_ \div 2$
$= \_\_\_\_ \div 2$
$= \_\_\_\_$

3. Evaluate.

a) $2^3 + (-1)^3 = \_\_\_\_ + (-1)^3$
$= \_\_\_\_ + (-1)^3$
$= \_\_\_\_ + \_\_\_\_ \_\_\_\_ \_\_\_\_$
$= \_\_\_\_ + \_\_\_\_$
$= \_\_\_\_$

b) $(2 - 1)^3 = \_\_\_\_$
$= \_\_\_\_$
$= \_\_\_\_$

c) $2^3 - (-1)^3 = \_\_\_\_ - (-1)^3$
$= \_\_\_\_ - (-1)^3$
$= \_\_\_\_ - \_\_\_\_ \_\_\_\_ \_\_\_\_$
$= \_\_\_\_ - \_\_\_\_$
$= \_\_\_\_$

d) $(2 + 1)^3 = \_\_\_\_$
$= \_\_\_\_$
$= \_\_\_\_$

4. Evaluate.

a) $3^2 \div (-1)^2 = \_\_\_\_ \div (-1)^2$
$= \_\_\_\_ \div (-1)^2$
$= \_\_\_\_ \div \_\_\_\_ \_\_\_\_$
$= \_\_\_\_ \div \_\_\_\_$
$= \_\_\_\_$

b) $(3 \div 1)^2 = \_\_\_\_^2$
$= \_\_\_\_$
$= \_\_\_\_$

c) $3^2 \times (-2)^2 = \_\_\_\_ \times (-2)^2$
$= \_\_\_\_ \times (-2)^2$
$= \_\_\_\_ \times \_\_\_\_$
$= \_\_\_\_ \times \_\_\_\_$
$= \_\_\_\_$

d) $5^2 \div (-5)^1 = \_\_\_\_ \div (-5)^1$
$= \_\_\_\_ \div (-5)^1$
$= \_\_\_\_ \div \_\_\_\_$
$= \_\_\_\_$