Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Objective

*Add and subtract numbers in scientific notation

*Introduce the prefix system

- **Common Core State Standards** *8.EE.4*

Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size…Interpret scientific notation that has been generated by technology.

- **Mathematical Practices** 1.Solve problems/persevere 6. Attend to precision.

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Quick Write-

Write and answer the following statement:

To add or subtract number in scientific notation, the powers of 10 must be the _____.

Quick Write-

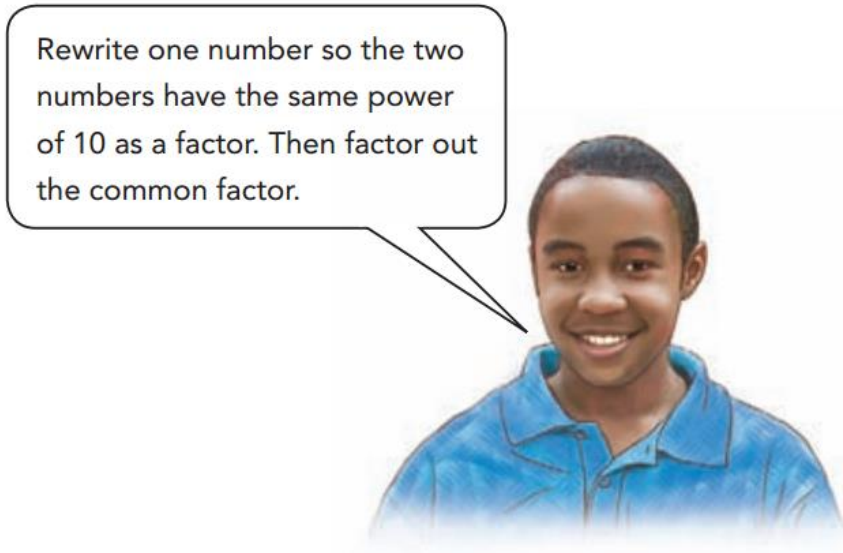
To add or subtract number in scientific notation, the powers of 10 must be the ____SAME_____.

To add or subtract numbers in scientific notation, the powers of 10 must be the same.

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 1 Adding and Subtracting Numbers in Scientific Notation with different exponents

Suppose, at the end of one winter, there are about $1.5 \cdot 10^7$ square kilometers of ice in the Arctic Ocean. By the end of summer, much of the ice has melted, and there are only about $7 \cdot 10^6$ square kilometers of ice. How much ice melted?



Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 1 Adding and Subtracting Numbers in Scientific Notation with different exponents

Area of ice melted

$= \text{Area of ice at end of winter} - \text{Area of ice at end of summer}$

$= 1.5 \cdot 10^7 - 7 \cdot 10^6$ Substitute.

$= 15 \cdot 10^6 - 7 \cdot 10^6$ Rewrite $1.5 \cdot 10^7$ as $15 \cdot 10^6$.

$= (15 - 7) \cdot 10^6$ Factor 10^6 from each term.

$= 8 \cdot 10^6 \text{ km}^2$ Write in scientific notation.

About $8 \cdot 10^6$ square kilometers of ice melted.

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 2 Adding and Subtracting Numbers in Scientific Notation with different exponents

The approximate area of the Pacific Ocean is $6.4 \cdot 10^7$ square miles. The area of the Arctic Ocean is about $5.4 \cdot 10^6$ square miles. a) Find the approximate sum of the areas of the two oceans.	Ask yourself .... *Can I rewrite the problem so the bases have the SAME power of ten?

You can also choose to rewrite the smaller area to have the same power of 10 as the larger area.

Sum of the areas of the two oceans
$= 6.4 \cdot 10^7 + 5.4 \cdot 10^6$ Substitute.
$= 6.4 \cdot 10^7 + 0.54 \cdot 10^7$ Rewrite $5.4 \cdot 10^6$ as $0.54 \cdot 10^7$.

The approximate area of the Pacific Ocean is $6.4 \cdot 10^7$ square miles. The area of the Arctic Ocean is about $5.4 \cdot 10^6$ square miles.

Solution

Approximate sum of the areas of the two oceans
$= 6.4 \cdot 10^7 + 5.4 \cdot 10^6$ Substitute.
$= 64 \cdot 10^6 + 5.4 \cdot 10^6$ Rewrite $6.4 \cdot 10^7$ as $64 \cdot 10^6$.
$= (64 + 5.4) \cdot 10^6$ Factor 10^6 from each term.
$= 69.4 \cdot 10^6$ Add within parentheses.
$= 6.94 \cdot 10^1 \cdot 10^6$ Write 69.4 in scientific notation.
$= 6.94 \cdot 10^{1+6}$ Use the product of powers property.
$= 6.94 \cdot 10^7 \text{ mi}^2$ Write in scientific notation.

Ask yourself....

*Can I rewrite the problem so the bases have the SAME power of ten?

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 2 Adding and Subtracting Numbers in Scientific Notation with different exponents

Example 2 (continued)

The approximate area of the Pacific Ocean is $6.4 \cdot 10^7$ square miles. The area of the Arctic Ocean is about $5.4 \cdot 10^6$ square miles.

b) About how much larger is the area of the Pacific Ocean than the area of the Arctic Ocean?

Ask yourself....

*Can I rewrite the problem so the bases have the SAME power of ten?

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 2 (continued)

The approximate area of the Pacific Ocean is $6.4 \cdot 10^7$ square miles. The area of the Arctic Ocean is about $5.4 \cdot 10^6$ square miles.

Solution

Difference in the areas of the two oceans

$= \text{Area of Pacific Ocean} - \text{Area of Arctic Ocean}$

$= 6.4 \cdot 10^7 - 5.4 \cdot 10^6$ Substitute.

$= 64 \cdot 10^6 - 5.4 \cdot 10^6$ Rewrite $6.4 \cdot 10^7$ as $64 \cdot 10^6$.

$= (64 - 5.4) \cdot 10^6$ Factor 10^6 from each term.

$= 58.6 \cdot 10^6$ Subtract within parentheses.

$= 5.86 \cdot 10^1 \cdot 10^6$ Write 58.6 in scientific notation.

$= 5.86 \cdot 10^{1+6}$ Use the product of powers property.

$= 5.86 \cdot 10^7 \text{ mi}^2$ Write in scientific notation.

The area of the Pacific Ocean is about $5.86 \cdot 10^7$ square miles larger than the area of the Arctic Ocean.

Ask yourself....

*Can I rewrite the problem so the bases have the SAME power of ten?

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Your Turn- Open Purple Math book

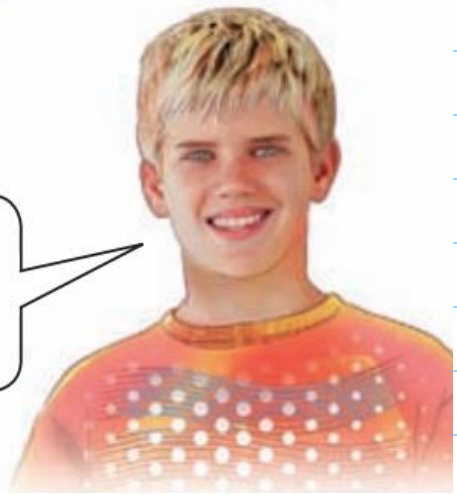
Guided Practice

Complete.

3 The approximate area of the continent of Australia is $9 \cdot 10^6$ square kilometers. The area of the continent of Antarctica is about $1.37 \cdot 10^7$ square kilometers.

a) Find the approximate sum of the land areas of the two continents.

Choose one of the land areas and rewrite it so that it has the same power of 10 as the other land area. Choose the larger land area.



Approximate sum of the land areas of the two continents

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Your Turn- Open Purple Math book

Approximate sum of the land areas of the two continents

= Area of Australia + Area of Antarctica

$= 9 \cdot 10^6 + 1.37 \cdot 10^7$	Substitute. 9; 10^6; 13.7; 10^6; 1.37;
$= \_?\_ \cdot \_?\_ + \_?\_ \cdot \_?\_$	Rewrite $\_?\_ \cdot \_?\_$ as $\_?\_ \cdot \_?\_$. 10^7; 13.7; 10^6
$= (\_?\_ + \_?\_) \cdot \_?\_$	Factor $\_?\_$ from each term. 9; 13.7; 10^6; 10^6
$= \_?\_ \cdot \_?\_$	$\_?\_$ within parentheses. 22.7; 10^6; Add
$= \_?\_ \cdot \_?\_ \cdot \_?\_$	Write $\_?\_$ in scientific notation. 2.27; 10^1; 10^6; 22.7
$= \_?\_ \cdot \_?\_$	Use the product of powers property. 2.27; 10^{1+6}
$= \_?\_ \cdot \_?\_ \text{ km}^2$	Write in scientific notation. 2.27; 10^7

The sum of the land areas is about $\_?\_$ square kilometers. $2.27 \cdot 10^7$

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Your Turn- Open Purple Math book

Guided Practice

Complete.

3 The approximate area of the continent of Australia is $9 \cdot 10^6$ square kilometers. The area of the continent of Antarctica is about $1.37 \cdot 10^7$ square kilometers.

a) Find the approximate sum of the land areas of the two continents.

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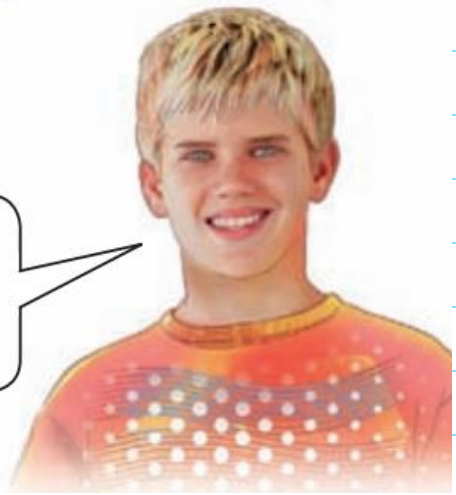

Approximate sum of the land areas of the two continents

b) What is the difference in the areas of the two continents?

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Your Turn- Open Purple Math book

b) What is the difference in the areas of the two continents?

Difference in the land areas

= Area of Antarctica − Area of Australia

= ? · ? − ? · ? Substitute. 1.37; 10^7; 9; 10^6

= ? · ? − ? · ? Rewrite ? · ? as ? · ?. 13.7; 10^6; 9; 10^6; 1.37; 10^7; 13.7; 10^6

= (? − ?) · ? Factor ? from each term. 13.7; 9; 10^6; 10^6

= ? · ? km^2 ? within parentheses. 4.7; 10^6; Subtract

The land area of Antarctica is about ? square kilometers larger than the land area of Australia. $4.7 \cdot 10^6$

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 3- Small Numbers

Example 3 (Very Small Numbers)	Ask yourself ….
A standard CD is about $1.2 \cdot 10^{-3}$ meter thick. A thin coating on the CD is approximately $7.0 \cdot 10^{-8}$ meter thick. a) How thick is the CD with the coating added? b) How much thicker is the CD than the coating?	*Can I rewrite the problem so the bases have the SAME power of ten?

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 3- Small Numbers

Example 3 (Very Small Numbers)

A standard CD is about $1.2 \cdot 10^{-3}$ meter thick. A thin coating on the CD is approximately $7.0 \cdot 10^{-8}$ meter thick.

a) How thick is the CD with the coating added?

Ask yourself ....

*Can I rewrite the problem so the bases have the SAME power of ten?

Approximate thickness of the CD and coating

= Thickness of CD + Thickness of coating

$= 1.2 \cdot 10^{-3} + 7.0 \cdot 10^{-8}$ Substitute.

$= 1.2 \cdot 10^{-3} + 0.00007 \cdot 10^{-3}$ Rewrite $7.0 \cdot 10^{-8}$ as $0.00007 \cdot 10^{-3}$.

$= (1.2 + 0.00007) \cdot 10^{-3}$ Factor 10^{-3} from each term.

$= 1.20007 \cdot 10^{-3}$ m Add within parentheses.

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2)

Example 3 (Very Small Numbers)

b) How much thicker is the CD than the coating?

A standard CD is about $1.2 \cdot 10^{-3}$ meter thick. A thin coating on the CD is approximately $7.0 \cdot 10^{-8}$ meter thick.

Ask yourself ....

*Can I rewrite the problem so the bases have the SAME power of ten?

Solution

Difference in thickness between the CD and coating

$= \text{Thickness of CD} - \text{Thickness of coating}$

$= 1.2 \cdot 10^{-3} - 7.0 \cdot 10^{-8}$ Substitute.

$= 1.2 \cdot 10^{-3} - 0.00007 \cdot 10^{-3}$ Rewrite $7.0 \cdot 10^{-8}$ as $0.00007 \cdot 10^{-3}$.

$= (1.2 - 0.00007) \cdot 10^{-3}$ Factor 10^{-3} from each term.

$= 1.19993 \cdot 10^{-3}$ m Add within parentheses.

The CD is about $1.19993 \cdot 10^{-3}$ meter thicker than the coating.

Lesson 2.2 Adding and Subtracting in Scientific Notation (Day 2

Independent Practice #3-5, 7, and 14-15

2.2 Independent Practice

Solve. Show your work. Round the coefficient to the nearest tenth.

3. $3.8 \cdot 10^3 + 5.2 \cdot 10^4$

4. $8.1 \cdot 10^5 - 2.8 \cdot 10^4$

The table shows the amounts of energy, in Calories, contained in various foods.

Food (per 100 g)	Energy (Cal)
Chicken breast	$1.71 \cdot 10^5$
Raw potato	$7.7 \cdot 10$
Cabbage	$2.5 \cdot 10^4$
Salmon	$1.67 \cdot 10^5$

5. Find the total energy in each food combination. Write your answer in scientific notation. Round coefficients to the nearest tenth.

   a) Chicken breast and cabbage

   b) Cabbage and raw potato

7. How many more Calories are in salmon than in cabbage?

Homework

Practice 2.1

Tell whether each number is written correctly in scientific notation. If incorrectly written, state the reason.

1. $71 \cdot 10^{22}$
2. $8 \cdot 10^{-2}$
3. $0.99 \cdot 10^{-3}$
4. $1.2 \cdot 10^4$

Write each number in scientific notation.

5. 533,000
6. 327.8
7. 0.0034
8. 0.00000728

Write each number in standard form.

9. $7.36 \cdot 10^3$
10. $2.431 \cdot 10^4$
11. $5.27 \cdot 10^{-2}$
12. $4.01 \cdot 10^{-4}$

Identify the lesser number in each pair of numbers. Justify your reasoning.

13. $8.7 \cdot 10^4$ and $5.9 \cdot 10^3$
14. $4.8 \cdot 10^3$ and $9.6 \cdot 10^7$
15. $3.1 \cdot 10^{-5}$ and $7.5 \cdot 10^{-5}$
16. $6.9 \cdot 10^{-3}$ and $4.3 \cdot 10^{-3}$

Lesson Check –Explain how to use scientific notation when calculating problems