Pre-Algebra Workbook Solutions

Scientific notation

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POWERS OF 10

■ 1. If we multiply a number by a power of 10, e can count the number of zeroes to know how many spaces to move the _____ to the _____.

Solution:

decimal point, right

■ 2. Find the product.

$$450 \cdot 10^0$$

Solution:

$$450 \cdot 1$$

$$450$$

■ 3. Find the quotient.

$$6.4 \div 100$$

Solution:

0.064

■ 4. Find the product.

$$3.5 \times 10^4$$

Solution:

35,000

■ 5. Find the product.

$$1.8 \times 10^{-2}$$

Solution:

0.018

■ 6. Find the quotient.

$$420 \div 10^3$$

Solution:

0.42

SCIENTIFIC NOTATION

■ 1. Scientific notation has 2 parts. The first part is the decimal number and the second part is the _____.

Solution:

power of 10

■ 2. The decimal number of a number written in scientific notation must be greater than or equal to 1 and less than _____.

Solution:

10

■ 3. Write the number in scientific notation.

0.000000056

Solution:

5.6×10^{-8}

■ 4. Write the number in scientific notation.

0.000000000000012

Solution:

1.2×10^{-13}

■ 5. Write number in expanded form.

7.2×10^{12}

Solution:

7,200,000,000,000

■ 6. Write number in expanded form.

4.9×10^{-7}

Solution:

0.00000049

MULTIPLYING SCIENTIFIC NOTATION

■ 1. Write the product $(3.1 \times 10^5)(5.5 \times 10^{-7})$ in scientific notation.

Solution:

Multiply the decimal numbers together, separately from the powers of 10.

$$(3.1 \times 5.5)(10^5 \times 10^{-7})$$

$$17.05 \times (10^5 \times 10^{-7})$$

To multiply the powers of 10, add the exponents.

$$17.05 \times 10^{5+(-7)}$$

$$17.05 \times 10^{5-7}$$

$$17.05 \times 10^{-2}$$

Proper scientific notation requires just one non-zero digit in front of the decimal point, which means we need to move the decimal point one place to the left. Therefore, we rewrite the expression as

$$1.705 \times 10^1 \times 10^{-2}$$

Now simplify the powers of 10 again.

$$1.705 \times 10^{1+(-2)}$$

$$1.705 \times 10^{1-2}$$

$$1.705 \times 10^{-1}$$

■ 2. Write the product $(1.8 \times 10^4)(5.9 \times 10^6)$ in scientific notation.

Solution:

Multiply the decimal numbers together, separately from the powers of 10.

$$(1.8 \times 5.9)(10^4 \times 10^6)$$

$$10.62 \times (10^4 \times 10^6)$$

To multiply the powers of 10, add the exponents

$$10.62 \times 10^{4+6}$$

$$10.62 \times 10^{10}$$

Proper scientific notation requires just one non-zero digit in front of the decimal point, which means we need to move the decimal point one place to the left. Therefore, we rewrite the expression as

$$1.062 \times 10^1 \times 10^{10}$$

Now simplify the powers of 10 again.

$$1.062 \times 10^{1+10}$$

$$1.062 \times 10^{11}$$

■ 3. Write the product $(8.8 \times 10^{-2})(7.85 \times 10^{-5})$ in scientific notation.

Solution:

Multiply the decimal numbers together, separately from the powers of 10.

$$(8.8 \times 7.85)(10^{-2} \times 10^{-5})$$

$$69.08 \times (10^{-2} \times 10^{-5})$$

To multiply the powers of 10, add the exponents.

$$69.08 \times 10^{-2+(-5)}$$

$$69.08 \times 10^{-2-5}$$

$$69.08 \times 10^{-7}$$

Proper scientific notation requires just one non-zero digit in front of the decimal point, which means we need to move the decimal point one place to the left. Therefore, we rewrite the expression as

$$6.908 \times 10^{1} \times 10^{-7}$$

Now simplify the powers of 10 again.

$$6.908 \times 10^{1+(-7)}$$

$$6.908 \times 10^{1-7}$$

$$6.908 \times 10^{-6}$$

■ 4. Write the product $(1.3 \times 10^3)(2.6 \times 10^{-4})$ in scientific notation.

Solution:

Multiply the decimal numbers together, separately from the powers of 10.

$$(1.3 \times 2.6)(10^3 \times 10^{-4})$$

$$3.38 \times (10^3 \times 10^{-4})$$

To multiply the powers of 10, add the exponents.

$$3.38 \times 10^{3+(-4)}$$

$$3.38 \times 10^{3-4}$$

$$3.38 \times 10^{-1}$$

■ 5. If we're given 3.6×10^{-2} in scientific notation, will we get a smaller or larger number when we multiply it by a positive power of 10?

Solution:

Let's pretend we're multiplying by 10^3. When we do, we get

$$3.6 \times 10^{-2} \times 10^3$$

$$3.6 \times 10^{-2+3}$$

$$3.6 \times 10^1$$

$$3.6 \times 10$$

$$36$$

This is a larger value than 3.6×10^{-2}, so we can say that multiplying by a positive power of 10 will give a larger number.

■ 6. Yvonne is asked to find the product of two numbers written in scientific notation:

$$(2.8 \times 10^4)(4.46 \times 10^{-6})$$

She solves the problem in three steps.

Step 1 $2.8 \times 4.46 = 12.488$

Step 2 $4 + (-6) = -2$

Step 3 12.488×10^{-2}

In what step did she make her mistake? What is the correct answer?

Solution:

She made her mistake in Step 3. She forgot to change the decimal back to a number between 1 and 10. She would get the correct answer in one more step:

$$1.2488 \times 10^{1} \times 10^{-2}$$

$$1.2488 \times 10^{1+(-2)}$$

$$1.2488 \times 10^{1-2}$$

$$1.2488 \times 10^{-1}$$

DIVIDING SCIENTIFIC NOTATION

■ 1. When we divide two numbers that have the same base, we _____ the exponents.

Solution:

subtract

■ 2. Find the value of $(1.5 \times 10^8) \div (2.0 \times 10^{-3})$.

Solution:

Divide the decimal numbers, separately from the powers of 10.

$$\frac{1.5}{2.0} \times \frac{10^8}{10^{-3}}$$

$$0.75 \times \frac{10^8}{10^{-3}}$$

To divide the powers of 10, subtract the exponent in the denominator from the exponent in the numerator.

$$0.75 \times 10^{8-(-3)}$$

$$0.75 \times 10^{8+3}$$

$$0.75 \times 10^{11}$$

Proper scientific notation requires one non-zero digit in front of the decimal point, which means we need to move the decimal point one place to the right. Therefore, we rewrite the expression as

$$7.5 \times 10^{-1} \times 10^{11}$$

$$7.5 \times 10^{-1+11}$$

$$7.5 \times 10^{10}$$

■ 3. Find the value of $(6.75 \times 10^3) \div (1.5 \times 10^9)$.

Solution:

Divide the decimal numbers, separately from the powers of 10.

$$\frac{6.75}{1.5} \times \frac{10^3}{10^9}$$

$$4.5 \times \frac{10^3}{10^9}$$

To divide the powers of 10, subtract the exponent in the denominator from the exponent in the numerator.

$$4.5 \times 10^{3-9}$$

$$4.5 \times 10^{-6}$$

■ 4. Find the value of $(2.75 \times 10^{10}) \div (8.0 \times 10^{8})$.

Solution:

Divide the decimal numbers, separately from the powers of 10.

$$\frac{2.75}{8.0} \times \frac{10^{10}}{10^{8}}$$

$$0.34375 \times \frac{10^{10}}{10^{8}}$$

To divide the powers of 10, subtract the exponent in the denominator from the exponent in the numerator.

$$0.34375 \times 10^{10-8}$$

$$0.34375 \times 10^{2}$$

Proper scientific notation requires one non-zero digit in front of the decimal point, which means we need to move the decimal point one place to the right. Therefore, we rewrite the expression as

$$3.4375 \times 10^{-1} \times 10^{2}$$

$$3.4375 \times 10^{-1+2}$$

$$3.4375 \times 10^{1}$$

■ 5. Find the value of $(7.5 \times 10^4) \div (1.5 \times 10^{-4})$.

Solution:

Divide the decimal numbers, separately from the powers of 10.

$$\frac{7.5}{1.5} \times \frac{10^4}{10^{-4}}$$

$$5 \times \frac{10^4}{10^{-4}}$$

To divide the powers of 10, subtract the exponent in the denominator from the exponent in the numerator.

$$5 \times 10^{4-(-4)}$$

$$5 \times 10^{4+4}$$

$$5 \times 10^8$$

$$5.0 \times 10^8$$

■ 6. If we're given 5.75×10^6 in scientific notation and we divide it by a negative power of 10, will we get a larger or smaller result?

Solution:

Let's pretend we're dividing by 10^{-2}. When we do, we get

$$5.75 \times 10^{6-(-2)}$$

$$5.75 \times 10^{6+2}$$

$$5.75 \times 10^{8}$$

This is a larger value than 5.75×10^{6}, so we can say that dividing by a negative power of 10 will give a larger number.

MULTIPLYING AND DIVIDING SCIENTIFIC NOTATION

■ 1. Simplify the expression.

$$\frac{(4.5 \times 10^{3})(1.4 \times 10^{-5})}{2.8 \times 10^{-1}}$$

Solution:

Simplify the numerator first by multiplying the scientific notation expressions.

$$\frac{(4.5 \times 1.4)(10^{3} \times 10^{-5})}{2.8 \times 10^{-1}}$$

$$\frac{6.3 \times 10^{3+(-5)}}{2.8 \times 10^{-1}}$$

$$\frac{6.3 \times 10^{-2}}{2.8 \times 10^{-1}}$$

Now divide the scientific notation.

$$\frac{6.3}{2.8} \times \frac{10^{-2}}{10^{-1}}$$

$$2.25 \times 10^{-2-(-1)}$$

$$2.25 \times 10^{-1}$$

■ 2. Simplify the expression.

$$\frac{(7.6 \times 10^5)(1.1 \times 10^{-7})}{5.1 \times 10^{-3}}$$

Solution:

Simplify the numerator first by multiplying the scientific notation expressions.

$$\frac{(7.6 \times 1.1)(10^5 \times 10^{-7})}{5.1 \times 10^{-3}}$$

$$\frac{8.36 \times 10^{5+(-7)}}{5.1 \times 10^{-3}}$$

$$\frac{8.36 \times 10^{-2}}{5.1 \times 10^{-3}}$$

Now divide the scientific notation.

$$\frac{8.36}{5.1} \times \frac{10^{-2}}{10^{-3}}$$

$$1.639 \times 10^{-2-(-3)}$$

$$1.639 \times 10^{1}$$

■ 3. Simplify the expression.

$$\frac{(1.7 \times 10^{-3})(3.4 \times 10^{-4})}{(6.3 \times 10^{-3})(7.3 \times 10^{-2})}$$

Solution:

Simplify the numerator and denominator first by multiplying the scientific notation expressions.

$$\frac{(1.7 \times 3.4)(10^{-3} \times 10^{-4})}{(6.3 \times 7.3)(10^{-3} \times 10^{-2})}$$

$$\frac{5.78 \times 10^{-3+(-4)}}{45.99 \times 10^{-3+(-2)}}$$

$$\frac{5.78 \times 10^{-7}}{45.99 \times 10^{-5}}$$

Now divide the scientific notation.

$$\frac{5.78}{45.99} \times \frac{10^{-7}}{10^{-5}}$$

$$0.126 \times 10^{-7-(-5)}$$

$$0.126 \times 10^{-2}$$

Move the decimal point one place to the right to put the result in proper scientific notation.

$$1.26 \times 10^{-1} \times 10^{-2}$$

$$1.26 \times 10^{-1+(-2)}$$

$$1.26 \times 10^{-3}$$

■ 4. Simplify the expression.

$$\frac{(4.9 \times 10^{4})(6.4 \times 10^{-4})}{(8.2 \times 10^{-3})(2 \times 10^{3})}$$

Solution:

Simplify the numerator and denominator first by multiplying the scientific notation expressions.

$$\frac{(4.9 \times 6.4)(10^{4} \times 10^{-4})}{(8.2 \times 2)(10^{-3} \times 10^{3})}$$

$$\frac{31.36 \times 10^{4+(-4)}}{16.4 \times 10^{-3+3}}$$

$$\frac{31.36 \times 10^{0}}{16.4 \times 10^{0}}$$

Any non-zero value raised to the power of 0 is 1, so

$$\frac{31.36 \times 1}{16.4 \times 1}$$

$$\frac{31.36}{16.4}$$

$$1.912$$

■ 5. Simplify the expression.

$$\frac{(6.1 \times 10^{6})(6.8 \times 10^{-4})}{(1.1 \times 10^{-5})(1.8 \times 10^{5})}$$

Solution:

Simplify the numerator and denominator first by multiplying the scientific notation expressions.

$$\frac{(6.1 \times 6.8)(10^{6} \times 10^{-4})}{(1.1 \times 1.8)(10^{-5} \times 10^{5})}$$

$$\frac{41.48 \times 10^{6+(-4)}}{1.98 \times 10^{-5+5}}$$

$$\frac{41.48 \times 10^{2}}{1.98 \times 10^{0}}$$

Now divide the scientific notation.

$$\frac{41.48}{1.98} \times \frac{10^{2}}{10^{0}}$$

$$20.949 \times 10^{2-0}$$

$$20.949 \times 10^{2}$$

Move the decimal point one place to the left to put the result in proper scientific notation.

$$2.0949 \times 10^{1} \times 10^{2}$$

$$2.0949 \times 10^{1+2}$$

$$2.0949 \times 10^{3}$$

■ 6. Danny and Deacon are working on finding the quotient below. Danny decides to multiply out the numerator and gets $10{,}000$ for the powers of 10 portion. Then he divides it by 0.00061 to get $16{,}393{,}442.6$ or 1.63934426×10^{7}. Deacon decides he wants to divide, so he divides each number by 0.00061 and gets $819{,}672{,}131$ and 32.78689852. Then he multiplies those numbers to get 2.68745×10^{10}. Why are the answers different? Who is correct?

$$\frac{(5 \times 10^{5})(2 \times 10^{-2})}{6.1 \times 10^{-4}}$$

Solution:

Deacon is incorrect. He should have divided just one of the numbers and then multiplied the other number by that quotient.

ESTIMATING SCIENTIFIC NOTATION

■ 1. Estimate the value of 3.65×10^{-5}.

Solution:

We'll round 3.65 up to the nearest whole number, 4, and then multiply that by 10^{-5}, or 0.00001.

$$4 \times 0.00001$$

$$0.00004$$

■ 2. Use scientific notation to estimate the value $(5.75 \times 10^{6})(2.34 \times 10^{-1})$.

Solution:

Round 5.75 to 6 and 2.34 to 2, then rewrite the expression as

$$(6 \times 10^{6})(2 \times 10^{-1})$$

$$(6 \times 2)(10^{6} \times 10^{-1})$$

$$12 \times 10^{5}$$

Rewrite the answer in proper scientific notation by moving the decimal point one place to the left.

$$1.2 \times 10^1 \times 10^5$$

$$1.2 \times 10^6$$

■ 3. Use scientific notation to estimate the value of $(2.456 \times 10^3)(1.67 \times 10^{-7})$.

Solution:

Round 2.456 to 2 and 1.67 to 2, then rewrite the expression as

$$(2 \times 10^3)(2 \times 10^{-7})$$

$$(2 \times 2)(10^3 \times 10^{-7})$$

$$4 \times 10^{-4}$$

■ 4. Use scientific notation to estimate the value of the expression.

$$\frac{7.152 \times 10^2}{2.91 \times 10^2}$$

Solution:

Round 7.152 to 7 and 2.91 to 3, then rewrite the expression as

$$\frac{7 \times 10^2}{3 \times 10^2}$$

$$\frac{7}{3} \times \frac{10^2}{10^2}$$

$$2.333 \times 1$$

$$2.333$$

■ 5. Use scientific notation to estimate the value of the expression.

$$\frac{(6.2 \times 10^6)(6.4 \times 10^{-3})}{(4.25 \times 10^{-2})(2.9 \times 10^{-3})}$$

Solution:

Round 6.2 to 6, 6.4 to 6, 4.25 to 4, and 2.9 to 3, then rewrite the expression as

$$\frac{(6 \times 10^6)(6 \times 10^{-3})}{(4 \times 10^{-2})(3 \times 10^{-3})}$$

$$\frac{(6 \times 6)(10^6 \times 10^{-3})}{(4 \times 3)(10^{-2} \times 10^{-3})}$$

$$\frac{36 \times 10^3}{12 \times 10^{-5}}$$

$$\frac{36}{12} \times \frac{10^3}{10^{-5}}$$

$$3 \times 10^8$$

■ 6. Use scientific notation to estimate the value of the expression.

$$\frac{(1.7 \times 10^{-5})(2.6 \times 10^2)}{(3.334 \times 10^{-3})(2.5 \times 10^{-1})}$$

Solution:

Round 1.7 to 2, 2.6 to 3, 3.334 to 3, and 2.5 to 3, then rewrite the expression as

$$\frac{(2 \times 10^{-5})(3 \times 10^2)}{(3 \times 10^{-3})(3 \times 10^{-1})}$$

$$\frac{(2 \times 3)(10^{-5} \times 10^2)}{(3 \times 3)(10^{-3} \times 10^{-1})}$$

$$\frac{6 \times 10^{-3}}{9 \times 10^{-4}}$$

$$\frac{6}{9} \times \frac{10^{-3}}{10^{-4}}$$

$$0.6667 \times 10^1$$

$$6.6667$$

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