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Skills Worksheet

Math Skills

The Law of Gravitation and Algebraic Rearrangement

In order to study gravity and its effects, scientists must use mathematical equations. To solve these equations, they use algebra and algebraic rearrangement.

Algebraic equations contain *constants* (numbers) and *variables* (unknowns represented by letters such as x or y.) To solve algebraic problems, you will need to determine the value of a variable. An algebraic equation involves one or more of the four basic mathematical operations: addition, subtraction, multiplication, and division.

The goal in solving an algebraic equation is to find the value of the the variable. To do so, remember that the value on one side of the equal sign must always be the same as the value on the opposite side. If you perform the same mathematical operation on both sides of the equal sign, the values will still be equal. To determine the value of the variable, reduce both sides of the equation to a simple statement that tells exactly what the variable equals.

SAMPLE PROBLEM:

A cargo plane is carrying special medical equipment to a hospital in northern Alaska. Its cargo's weight in flight is 1,500 kg. The plane is flying at a height where a given mass weighs two-thirds of its weight on Earth. How much does that equipment weigh when it reaches its destination?

Step 1: Write this word problem as an algebraic equation.

x = weight of the equipment on on the ground in Alaska

$$\tfrac{2}{3}x = 1{,}500$$

Step 2: Calculate.

In this case, to solve for x, multiply both sides by $\frac{3}{2}$. The result is the following:

$$\tfrac{3}{2} \times \tfrac{2}{3}x = \tfrac{3}{2} \times 1{,}500$$

$$1x = \tfrac{3}{2} \times 1{,}500$$

$$x = 2{,}250 \text{ kg on the ground in Alaska}$$

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Math Skills *continued*

PRACTICE

Using the sample problem as a guide, solve the following problems. Remember to show your work.

1. A weather satellite is carrying meteorological equipment to chart hurricane activity over the course of a year. That equipment weighs 4,800 newtons (N) on the ground. If the weight of a mass at 19,778 km from Earth's center is only 10% of the weight of the mass on Earth, how much will the weather equipment weigh when the satellite is in space, 19,788 km from Earth's core?

   Write this word problem as an algebraic equation:

   Calculate your answer:

2. $12x + 43 = 247$

3. $(4x + 10)/2 - 4 = 22$

4. $6x/3 - 16 = 6$

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Skills Worksheet

Graphing Skills

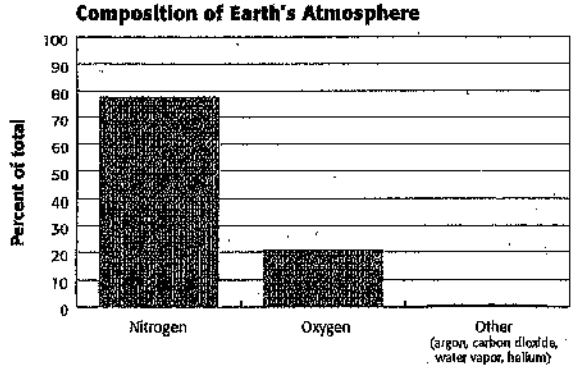
Bar Graphs

Bar graphs are useful tools for use in comparing data values. For example, you might compare the temperature differences in various layers of the atmosphere. Or, you might compare the percentages of gases that make up Earth's atmosphere. Take a look at the following chart.

COMPOSITION OF EARTH'S ATMOSPHERE

Gases	Percent of total
Nitrogen	78
Oxygen	21
Other (argon, carbon dioxide, water vapor, helium)	1

To create a bar graph from the data in this table, you would label three bar positions on the *x*-axis with the names of the gases. On the *y*-axis you would include the percent range from 0 to 100 and label this axis "Percent of total." Finally, you would draw the bars to represent the data. Your bar graph would look like the following sample.



PRACTICE

Answer the following questions based on the information in the graph above.

1. Which gas has the highest concentration in Earth's atmosphere? What percent of the atmosphere is it?

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Graphing Skills *continued*

2. Which gas or group of gases has the lowest concentration? What is its percentage?

3. Which gas has the second highest concentration? What is its percentage?

4. The following table shows what happens to solar radiation that enters Earth's atmosphere. Some is absorbed, and some is reflected back into space. Create a bar graph illustrating this information using the grid provided.

INCOMING SOLAR RADIATION

What happens to solar radiation	Percent of Total
Absorbed by water and land	51
Absorbed by atmosphere	19
Reflected back to space	30