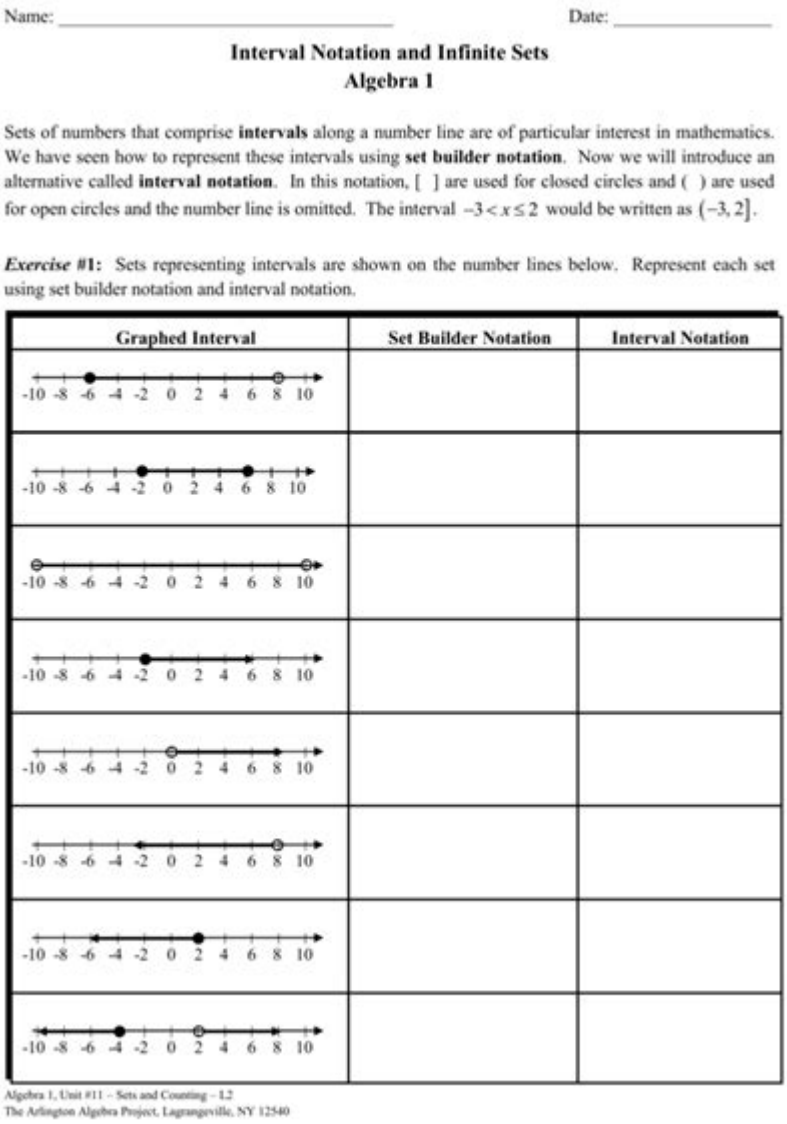
Interval Notation Worksheet



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Interval Notation and Infinite Sets
Algebra 1

Sets of numbers that comprise **intervals** along a number line are of particular interest in mathematics. We have seen how to represent these intervals using **set builder notation**. Now we will introduce an alternative called **interval notation**. In this notation, [ ] are used for closed circles and ( ) are used for open circles and the number line is omitted. The interval $-3 < x \leq 2$ would be written as $(-3, 2]$.

Exercise #1: Sets representing intervals are shown on the number lines below. Represent each set using set builder notation and interval notation.

Graphed Interval	Set Builder Notation	Interval Notation
-10 -8 -6 -4 -2 0 2 4 6 8 10		
-10 -8 -6 -4 -2 0 2 4 6 8 10		
-10 -8 -6 -4 -2 0 2 4 6 8 10		
-10 -8 -6 -4 -2 0 2 4 6 8 10		
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-10 -8 -6 -4 -2 0 2 4 6 8 10		
-10 -8 -6 -4 -2 0 2 4 6 8 10		

Algebra 1, Unit #11 – Sets and Counting – L2
The Arlington Algebra Project, Lagrangeville, NY 12540

Interval notation worksheet is an essential tool in mathematics, particularly in algebra and calculus. It provides a concise way to represent the set of all numbers between specific endpoints, making it easier to express ranges of values. This notation is particularly useful when dealing with inequalities, functions, and real number sets. In this article, we will explore what interval notation is, how it works, and provide a comprehensive worksheet that includes examples and exercises to solidify your understanding.

Understanding Interval Notation

Interval notation is a mathematical notation used to describe a set of numbers that fall within a certain range. It is often presented in the form of parentheses and brackets, which indicate whether the endpoints are included in the interval.

Types of Intervals

Intervals in mathematics can be classified into several types based on whether their endpoints are included or excluded. Here are the primary types of intervals:

1. Open Interval: An open interval is represented by parentheses and does not include its endpoints. For example, the interval (a, b) includes all numbers greater than 'a' and less than 'b' but does not include 'a' and 'b'.

2. Closed Interval: A closed interval is represented by brackets and includes both endpoints. For instance, the interval [a, b] includes all numbers from 'a' to 'b', including 'a' and 'b'.

3. Half-Open (or Half-Closed) Interval: A half-open interval includes one endpoint but not the other. It can be represented in two ways:
- [a, b) includes 'a' but not 'b'.
- (a, b] includes 'b' but not 'a'.

4. Infinite Intervals: These intervals extend indefinitely in one or both directions. Here are examples:
- (-∞, b) includes all numbers less than 'b'.
- (a, ∞) includes all numbers greater than 'a'.
- (-∞, ∞) includes all real numbers.

How to Write Intervals

Writing intervals in notation involves identifying the endpoints and determining whether they are included or excluded. Here’s a step-by-step guide:

1. Identify the Endpoints: Look for the smallest and largest values in the set you want to describe.

2. Determine Inclusion: Decide if the endpoints should be included in the interval:
- Use parentheses for exclusion.
- Use brackets for inclusion.

3. Combine the Information: Write the interval using the identified endpoints and the appropriate symbols.

Examples

Let’s illustrate these steps with some examples:

- For the set of numbers greater than 3 and less than 8:
- Interval notation: (3, 8)

- For the set of numbers from -2 to 4, including both endpoints:

- Interval notation: [-2, 4]

- For the set of numbers from -5 to 2, including -5 but not 2:
- Interval notation: [-5, 2)

- For the set of all numbers greater than or equal to 1:
- Interval notation: [1, ∞)

Applications of Interval Notation

Interval notation is widely used in various branches of mathematics. Here are some key applications:

1. Solving Inequalities

Inequalities often require a range of solutions, which can be effectively expressed using interval notation. For example:

- The inequality $x > 5$ can be represented as $(5, \infty)$.
- The inequality $-3 \leq x < 4$ can be denoted as $[-3, 4)$.

2. Function Domains and Ranges

When dealing with functions, interval notation is useful for specifying the domain (the set of input values) and range (the set of output values):

- For the function $f(x) = \sqrt{x}$, the domain is $[0, \infty)$ because square roots of negative numbers are not defined in the real number set.
- For $f(x) = 1/x$, the domain is $(-\infty, 0) \cup (0, \infty)$ since x cannot equal zero.

3. Graphing

Interval notation can simplify the process of graphing functions and inequalities. It provides a clear indication of which portions of the number line to shade or include in a graph.

Interval Notation Worksheet

Now that we understand interval notation, let’s create a worksheet that includes different types of exercises to practice this concept.

Exercise 1: Write in Interval Notation

Convert the following inequalities into interval notation:

1. $x < 2$
2. $-1 \leq x \leq 3$
3. $x > 4$
4. $-5 < x < 1$
5. $x \leq -2$ or $x > 3$

Exercise 2: Identify the Type of Interval

For the following intervals, identify whether they are open, closed, or half-open:

1. $(3, 7)$
2. $[0, 10)$
3. $(-\infty, 5]$
4. $(-3, \infty)$
5. $[-2, -1]$

Exercise 3: Graphing Intervals

Graph the following intervals on a number line:

1. $[1, 4)$
2. $(-2, 3]$
3. $(5, \infty)$
4. $(-\infty, 0)$
5. $[-5, -3) \cup (-1, 2)$

Exercise 4: Determine Domain and Range

For the following functions, determine the domain and range using interval notation:

1. $f(x) = x^2 - 1$
2. $g(x) = 1/(x - 2)$
3. $h(x) = \sqrt{(x + 4)}$
4. $j(x) = |x - 3|$

Exercise 5: Mixed Problems

Convert the following sets into interval notation and identify if they are open, closed, or half-open:

1. The set of all real numbers except -1.
2. The set of numbers between -3 and 5, including both -3 and 5.
3. The set of numbers less than or equal to 0.
4. The set of all x such that $2 < x < 7$, excluding 2 and including 7.

Conclusion

Interval notation is a powerful mathematical tool that simplifies the representation of ranges of numbers. By understanding how to write and interpret intervals, students can enhance their ability to solve inequalities, determine function domains and ranges, and graph mathematical concepts effectively. The exercises provided in this worksheet aim to reinforce these skills, making interval notation a foundational aspect of mathematical education. Whether you are a student, a teacher, or someone looking to refresh your knowledge, mastering interval notation will undoubtedly benefit you in your mathematical journey.

Frequently Asked Questions

What is interval notation?

Interval notation is a way of writing subsets of the real number line. It uses parentheses and brackets to indicate whether endpoints are included or excluded.

How do you represent an open interval in interval notation?

An open interval is represented by using parentheses. For example, the open interval from 2 to 5 is written as (2, 5).

What does a closed interval look like in interval notation?

A closed interval includes its endpoints and is represented using brackets. For example, the closed interval from 2 to 5 is written as [2, 5].

What is the difference between a closed interval and a half-open interval?

A closed interval includes both endpoints, while a half-open interval includes one endpoint and excludes the other. For example, [2, 5) is closed at 2 and open at 5.

How do you express the union of two intervals in interval notation?

The union of two intervals is expressed using the symbol 'U'. For example, the union of (1,

3) and [5, 7) is written as (1, 3) U [5, 7).

What is the interval notation for all real numbers?

All real numbers are represented in interval notation as (-∞, ∞).

How do you convert a number line representation to interval notation?

To convert from number line representation to interval notation, identify the endpoints shown on the number line and use parentheses or brackets based on whether the endpoints are included or excluded.

Can interval notation be used for infinite intervals?

Yes, interval notation can represent infinite intervals using symbols like ∞ or -∞. For example, (-∞, 3) represents all numbers less than 3.

What is the proper way to write the interval for all numbers greater than or equal to 0?

The interval for all numbers greater than or equal to 0 is written as [0, ∞).

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