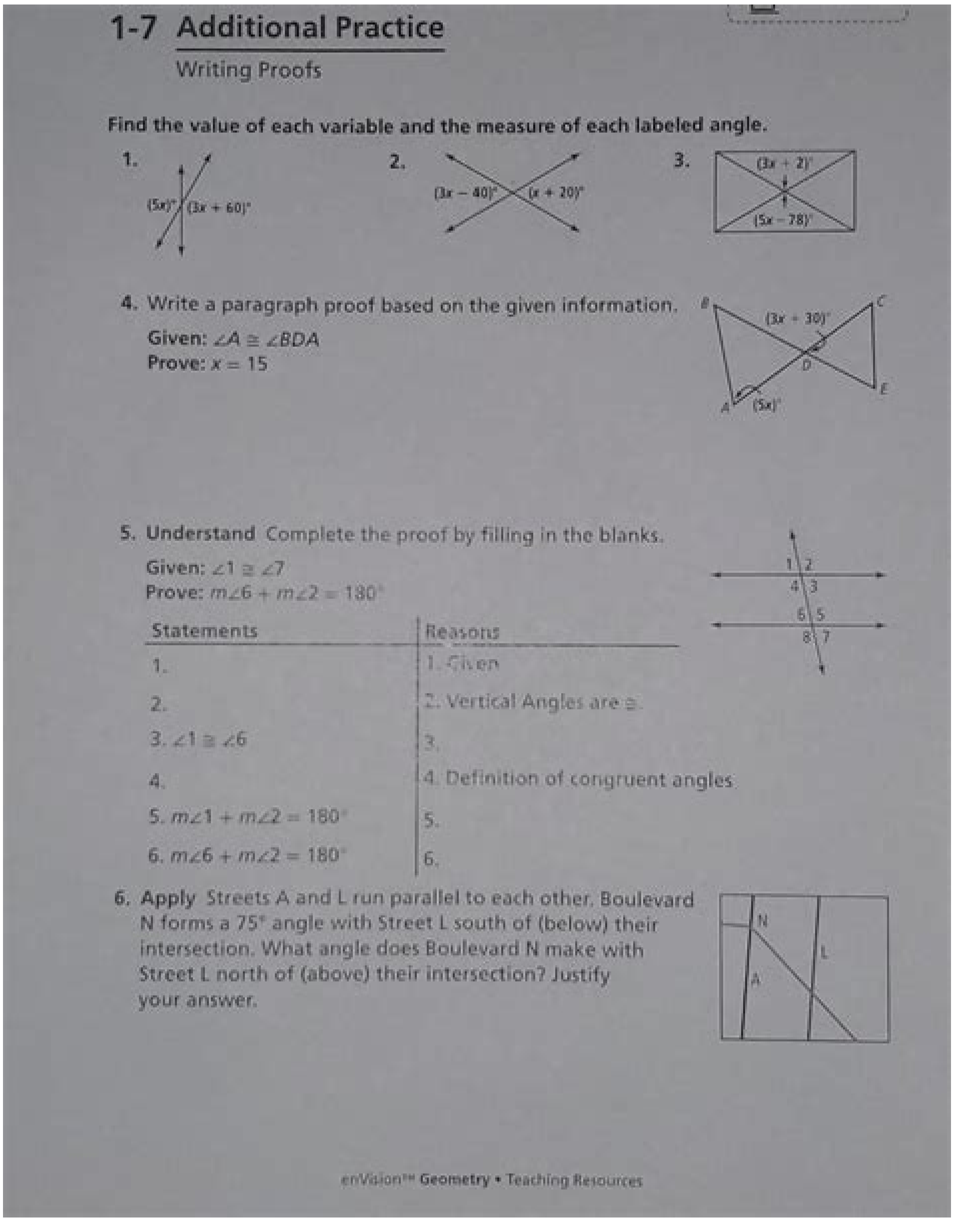
1 7 Additional Practice Writing Proofs



1-7 Additional Practice

Writing Proofs

Find the value of each variable and the measure of each labeled angle.

1. $(5x)°$, $(3x + 60)°$

2. $(3x - 40)°$, $(x + 20)°$

3. $(3x + 2)°$, $(5x - 78)°$

4. Write a paragraph proof based on the given information.

Given: $\angle A \cong \angle BDA$

Prove: $x = 15$

5. Understand Complete the proof by filling in the blanks.

Given: $\angle 1 \cong \angle 7$

Prove: $m\angle 6 + m\angle 2 = 180°$

Statements	Reasons
1.	1. Given
2.	2. Vertical Angles are ≅.
3. $\angle 1 \cong \angle 6$	3.
4.	4. Definition of congruent angles
5. $m\angle 1 + m\angle 2 = 180°$	5.
6. $m\angle 6 + m\angle 2 = 180°$	6.

6. Apply Streets A and L run parallel to each other. Boulevard N forms a 75° angle with Street L south of (below) their intersection. What angle does Boulevard N make with Street L north of (above) their intersection? Justify your answer.

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1 7 additional practice writing proofs is an essential skill for students in mathematics, particularly in geometry and higher-level mathematics courses. Proof writing not only helps to solidify concepts but also enhances critical thinking and logical reasoning abilities. This article aims to provide comprehensive guidance on writing proofs, accompanied by examples and exercises for practice. We will explore various types of proofs, techniques for constructing them, and additional resources to aid in the learning process.

Understanding Proofs

Proofs are logical arguments that demonstrate the truth of a mathematical statement. They are a fundamental part of mathematics, allowing mathematicians to validate conjectures and theorems. There are several key components of proofs, including:

- Definitions: Clear and precise explanations of mathematical terms.
- Theorems: Statements that have been proven based on previously established statements.
- Axioms/Postulates: Basic assumptions that are accepted without proof.
- Logical reasoning: The process of deriving conclusions from premises using valid reasoning.

Types of Proofs

There are several different forms of proofs, each suitable for various contexts:

1. Direct Proof: This method involves assuming the hypothesis of a theorem is true and using logical reasoning to show that the conclusion must also be true.

2. Indirect Proof (Proof by Contradiction): In this method, you assume that the conclusion is false and show that this assumption leads to a contradiction.

3. Proof by Contrapositive: This approach involves proving that if the conclusion is false, then the hypothesis must also be false. This is often useful for implications.

4. Proof by Induction: This technique is used to prove statements about natural numbers. It consists of two steps: proving the base case and proving that if the statement holds for an arbitrary case, it holds for the next case as well.

5. Existential Proof: This proof demonstrates that at least one example exists that satisfies a given condition.

6. Constructive Proof: This involves providing a specific example or construction to demonstrate the truth of a statement.

7. Non-constructive Proof: In contrast to constructive proofs, non-constructive proofs show that a statement is true without providing an explicit example.

Techniques for Writing Proofs

Writing effective proofs requires practice and familiarity with certain techniques. Here are several strategies to improve your proof-writing skills:

1. Understand the Statement

Before attempting to write a proof, make sure you fully understand the statement you are trying to prove. Break it down into smaller components if necessary. Identify the hypothesis and conclusion, and consider what definitions or theorems might be relevant.

2. Draw Diagrams

In geometry, visualizing a problem through diagrams can greatly aid in understanding. Sketching can help clarify relationships between elements and provide insight into how to approach the proof.

3. Work with Examples

Before constructing a formal proof, try to work through specific examples. This can help you identify patterns and develop intuition about the problem.

4. Use Logical Structure

A well-organized proof follows a logical structure. Start with the assumptions, clearly state what you are trying to prove, and then proceed step-by-step toward the conclusion.

5. Keep it Concise

While it's essential to provide enough detail to make your argument clear, be careful not to include unnecessary information. Aim for clarity and conciseness.

6. Review and Revise

Proof writing, like any other skill, improves with practice. After drafting your proof, take the time to review and revise it. Look for any gaps in logic or areas where the argument could be made clearer.

Examples of Proofs

To illustrate the principles discussed, we will present a few example proofs.

Example 1: Direct Proof

Statement: If n is an even integer, then n^2 is also even.

Proof:

Assume that n is an even integer. By definition, this means that there exists an integer k such that $n = 2k$.

Now, we compute n^2:

$$n^2 = (2k)^2 = 4k^2 = 2(2k^2).$$

Since $2k^2$ is an integer, we conclude that n^2 is even.
Therefore, if n is even, then n^2 is also even.

Example 2: Proof by Contradiction

Statement: $\sqrt{2}$ is irrational.

Proof:

Assume, for the sake of contradiction, that $\sqrt{2}$ is rational. This means it can be expressed as a fraction $\frac{a}{b}$, where a and b are integers with no common factors, and $b \neq 0$.

Then we have:
$$
\sqrt{2} = \frac{a}{b} \implies 2 = \frac{a^2}{b^2} \implies a^2 = 2b^2.
$$
This implies that a^2 is even, and hence a must also be even (since the square of an odd number is odd).

So we can write $a = 2k$ for some integer k. Substituting back gives:
$$
(2k)^2 = 2b^2 \implies 4k^2 = 2b^2 \implies b^2 = 2k^2.
$$
This shows that b^2 is even, and thus b is also even.

Since both a and b are even, they have a common factor of 2, which contradicts our assumption that a and b have no common factors. Therefore, $\sqrt{2}$ must be irrational.

Example 3: Proof by Induction

Statement: For all $n \in \mathbb{N}$, the sum of the first n positive integers is given by the formula $S(n) = \frac{n(n+1)}{2}$.

Proof:

Base Case: For $n = 1$,
$$
S(1) = 1 = \frac{1(1+1)}{2}.
$$
The base case holds.

Inductive Step: Assume the statement is true for $n = k$; that is, $S(k) = \frac{k(k+1)}{2}$.

Now, consider $n = k + 1$:
$$
S(k + 1) = S(k) + (k + 1).
$$
Substituting the inductive hypothesis:
$$
S(k + 1) = \frac{k(k + 1)}{2} + (k + 1) = \frac{k(k + 1) + 2(k + 1)}{2} =
$$

\frac{(k + 1)(k + 2)}{2}.
\]
Thus, the statement holds for \(n = k + 1 \).

By the principle of mathematical induction, the statement is true for all natural numbers \(n \).

Practice Exercises

To solidify your understanding of writing proofs, practice the following exercises:

1. Prove that the sum of two odd integers is even.
2. Prove that if \(a \) and \(b \) are both even integers, then \(a + b \) is even.
3. Prove by induction that \(3^n - 1 \) is divisible by 2 for all \(n \geq 1 \).
4. Show that the square of an odd integer is odd.
5. Prove that there are infinitely many prime numbers.

Conclusion

Writing proofs is a fundamental skill in mathematics that requires practice, logical reasoning, and a clear understanding of mathematical concepts. By familiarizing yourself with various types of proofs, employing effective techniques, and practicing regularly, you can enhance your proof-writing ability. Remember to review your work and seek feedback to continue improving. The exercises provided will serve as an excellent starting point for your journey in mastering mathematical proofs. With time and practice, you'll find that writing proofs becomes a valuable and rewarding skill.

Frequently Asked Questions

What is the purpose of additional practice in writing proofs?

The purpose of additional practice in writing proofs is to enhance understanding of logical reasoning, improve problem-solving skills, and build confidence in constructing valid arguments in mathematics.

How can I effectively approach writing proofs in geometry?

To effectively approach writing proofs in geometry, start by clearly understanding the given information, identifying what needs to be proven, and then use logical steps, definitions, and theorems to construct a coherent argument.

What are some common types of proofs I should practice?

Common types of proofs to practice include direct proofs, indirect proofs (proofs by contradiction), and proofs by induction, as each type develops different reasoning skills and approaches to problem-solving.

Why is it important to understand definitions and theorems before writing proofs?

Understanding definitions and theorems is crucial because they provide the foundational knowledge and context necessary for constructing valid logical arguments and justifying each step in the proof.

What resources can I use for additional practice in writing proofs?

Resources for additional practice in writing proofs include textbooks with exercises, online platforms offering proof-writing problems, and math tutoring services that focus on logical reasoning and proof techniques.

How can peer review help improve my proof-writing skills?

Peer review can help improve proof-writing skills by providing constructive feedback, exposing you to different approaches and perspectives, and encouraging collaboration, which can deepen your understanding of the material.

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