DigitLit math instruction

Lesson 3.02 Axioms of equality

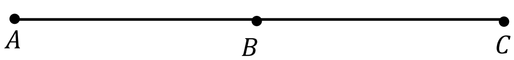
Students will be able to:

- Content Objective: Define addition, subtraction, and substitution axioms of equality and use them to construct proofs.
- Language Objective: Verbally express and write detailed steps for proving that vertical angles are equal.

Warm Up

Write a **congruence** and **equality** statement for each and express the segment and angle below as a sum by filling in the blanks with the correct notation.

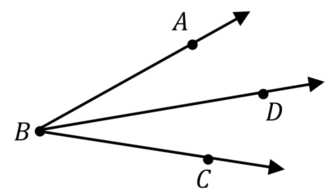
a. B is the midpoint of $\overline{AC}$.



Congruence Statement: ____________________

Equality Statement: $AC =$ ________ + ________

b. $\overrightarrow{BD}$ is the angle bisector of $\angle ABC$.



Congruence Statement: ____________________

Equality Statement: $m\angle ABC =$ ________ + ________

Segment & Angle Addition Postulate
The whole is equal to the sum of its parts.

Vocabulary Review

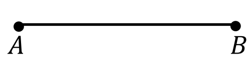
As powerful as our brains are, sometimes they can be tricked. This happens in geometry when concepts seem to be true only to find out that they are not. For example, two lines could look parallel when they are in fact not. This is a small example of why it is important to learn **proofs**; so that we can be 100% sure that what we are learning is correct. However, we can't write a proof from nothing, we need building blocks or, **axioms** and **postulates,** to construct our proofs.

Postulate: True assumptions that are specific to geometry.

Axiom: True assumptions used throughout all mathematics and not specifically linked to geometry.

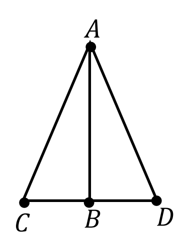
Symmetric Property of Equality

$$AB = BA$$



Reflexive Property of Equality

$$AB = AB$$



Graphic Organizer

Addition Axiom of Equality

When equal parts are added to equal parts, their sums are equal.

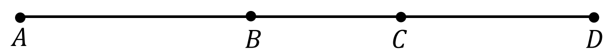
Subtraction Axiom of Equality

When equal parts are subtracted from equal parts, their differences are equal.

Skill 1: Addition Axiom and Segments

Given: The diagram with $AB = CD$

Prove: $AC = DB$

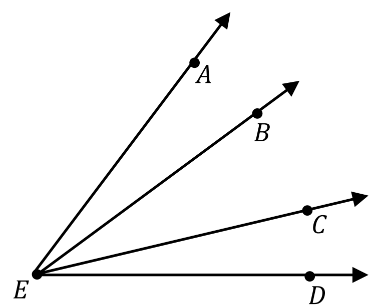


Statement	Reason

Exercise 1: Addition Axiom and Angles

Given: The diagram with $m\angle AEB = m\angle DEC$

Prove: $m\angle AEC = m\angle DEB$



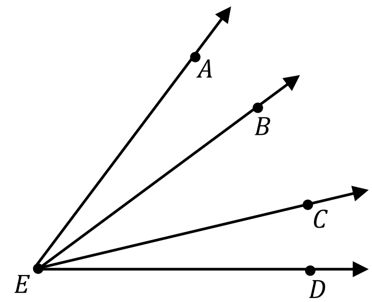
Statement	Reason
(1) The diagram with $m\angle AEB = m\angle DEC$	(1) ______________________
(2) ______________________	(2) Reflexive Property
(3) $m\angle AEB + m\angle BEC = m\angle DEC + m\angle BEC$	(3) ______________________ ______________________
(4) ______________________	(4) The Whole is equal to the sum of its parts

Let's use the same diagram from exercise #2 to prove the subtraction axiom in the next skill.

Skill 2: Subtraction Axiom & Angles

Given: The diagram with $m\angle AEC = m\angle DEB$

Prove: $m\angle AEB = m\angle DEC$



Statement	Reason

Up until this point in the lesson, we have used the **reflexive property** in every proof. That's because we encountered instances of **shared segments** or **shared angles**. Let's look at a proof that does not use the reflective property but similarly, the **substitution property.**

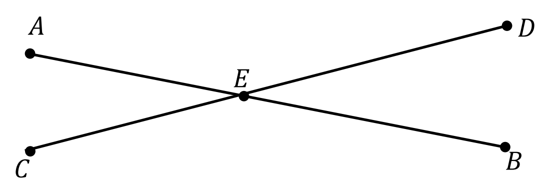
Substitution Axiom of Equality

If two quantities are equal, then one can be replaced by the other

Exercise 2: Subtraction Axiom and Segments

Given: The diagram with $AB = CD$, and $ED = EB$.

Prove: $AE = CE$



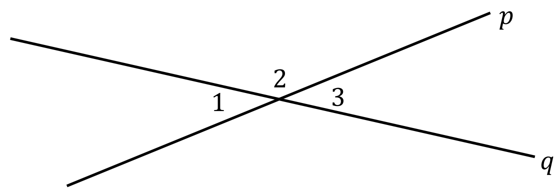
Statement	Reason
(1) ______________________	(1) ________________
(2) $AE + EB = CE + ED$	(2) ______________________ ______________________
(3) ______________________	(3) Substitution Property
(4) ______________	(4) Subtraction property of equality

In unit 1, we used measurement to conclude that **vertical angles** are congruent. Now that we have a basic understanding of proofs, lets prove that vertical angles are **equal in measure**.

Talk it Out

Given: Lines p and q intersect to form $\angle 1, \angle 2$, and $\angle 3$.

Prove: $m\angle 1 = m\angle 3$ (Vertical angles are equal)



Statement	Reason

Check Point

How are you feeling about proof writing? Check all that apply.

_____ Great. I feel comfortable with knowing and using axioms to construct proofs.

_____ Optimistic. I understand the important axioms for writing proofs but need more practice.

_____ Just Ok. I need to review the important axioms necessary for constructing a correct proof.

_____ Overwhelmed. The concepts in this course are building quickly and I need to attend extra help.

_____ Other: ____

3.02- Problem Set

Name: ____

1. Identify whether each of the following notations is referring to geometric figure or measurement.

a. $\angle Q$ b. $\overline{AB}$ c. AB

d. $AB = BC$ e. $m\angle Q$ f. $\overline{AB} \cong \overline{BC}$

2. Giacomo is writing a proof using angles and states that $m\angle 1 + m\angle 2 = m\angle 2 + m\angle 3$. Which of the following axioms will allow Giacomo to conclude that $\angle 1$ and $\angle 3$ have the same measure?

    1) The substitution axiom
    2) The subtraction axiom
    3) The addition axiom
    4) Symmetric axiom

3. The diagram below shows ΔABC, with $\overline{BD}$ being perpendicular to $\overline{AC}$. Which of the following must be true? Check all that apply.

_______ D is the midpoint of AC.

_______ $\angle ADB$ and $\angle CDB$ are right angles.

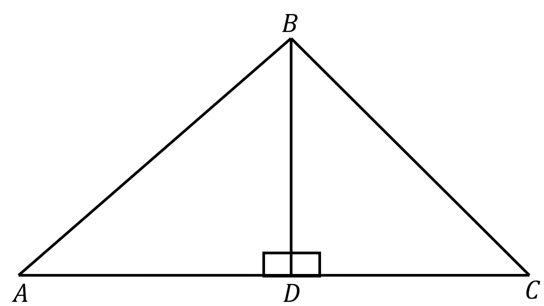
_______ $AD = CD$

_______ $\angle ADB \cong \angle CDB$

_______ $\overline{BD}$ is the altitude of ΔABC.

_______ $\overline{BD}$ is the median of ΔABC.

_______ $m\angle ADB = m\angle CDB$



4. Consider a similar triangle to question 3, where $\overline{BD} \perp \overline{AC}$. Fill in the blanks below to reason that $m\angle ADB = m\angle CDB$.

Statement	Reason
(1) ΔABC with $\overline{BD}$ perpendicular to $\overline{AC}$.	(1) ____________________
(2) $\angle ADB$ and $\angle CDB$ are right angles.	(2) ____________________
(3) $\angle ADB \cong \angle CDB$	(3) ____________________
(4) $m\angle ADB \cong m\angle CDB$	(4) Definition of Congruence