Lesson 3.01 Properties, Postulates, & Theorems

Students will be able to:

- Content Objective: State conclusions based on geometric terminology.

- Language Objective: Write detailed conclusions and reasonings to prove two lines are parallel.

Warm Up

Point $A(-3,1)$ is shown graphed below.

a. Graph its image A' after a reflection over the line $x = 2$. Label this point on the graph.

b. Connect points A and A' to form segment AA'. What is the midpoint of this line segment? Label this point M on the graph.

c. What can we conclude about $\overline{AM}$ and $\overline{A'M}$?
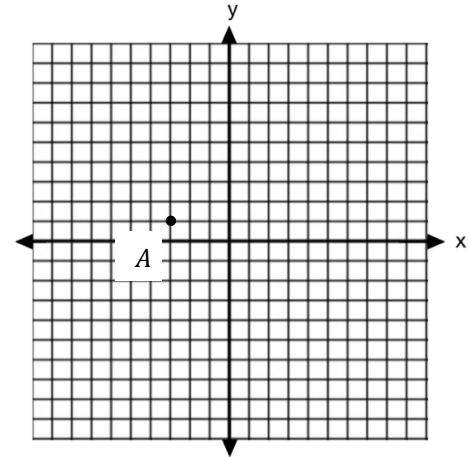
We were able to make the conclusion in part c. of the warmup due to geometric facts we know and assume to be true. Eventually in this course, we will be writing extensive proofs of theorems. To do so, it is essential that we are well versed in important postulates and foundational properties.

Vocabulary Review

Postulate	Theorem
A statement that we can assume true without a proof.	A true statement that can be proven.

Graphic Organizer

Given M is the midpoint of $\overline{XY}$, what can we prove?

Statement

- Conclusions stated from properties and postulates.

- We write statements on the left side of a two column proof.

Statement:
$$\overline{XM} \cong \overline{YM}$$

Reason

- Sentence explaining the corresonding statement.

- We write reasons on the right side of a two column proof.

Reason:
A midpoint divides a segment into two congruent segments.

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Skill 1: Review Important Terminology

Fill in the blanks below with the correct word.

1. **Segment Bisector:** A segment bisector intersects a _____ to form two congruent _____.

2. **Reflexive Property of Congruence:** A line segment, angle, or shape is _____ to itself at all times.

3. **Perpendicular Lines:** Perpendicular lines intersect to form _____ angles.

4. **Isosceles Triangle:** An isosceles triangle has two congruent _____ and two congruent _____ angles.

Exercise 1: Review Important Terminology

Fill in the blanks below with the correct word.

1. **Angle Bisector:** An Angle Bisector divides an _____ into two congruent _____.

2. **Right Angles:** All right angles are _____ because they each measure _____ degrees.

3. **Midpoint:** A midpoint divides a _____ into two congruent _____.

Skill 2: Writing Statements & Reasons

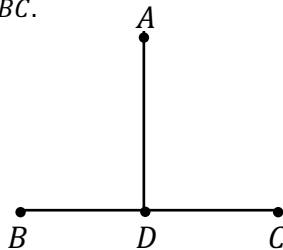Write the statement (conclusion) and reason for each given diagram below.

a. Given: $\overline{XY}$ is the segment bisector of $\overline{AB}$ with K being the intersection point.
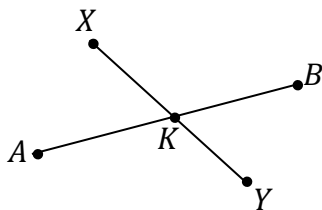
Statement:

Reason:

b. Given: $\overline{AB}$ is perpendicular to $\overline{BC}$.
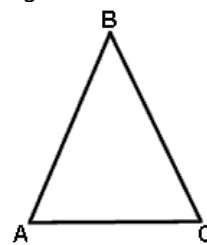

Statement #1:

Reason

Statement #2:

Reason:

c. Given: ΔABC is an isosceles triangle.
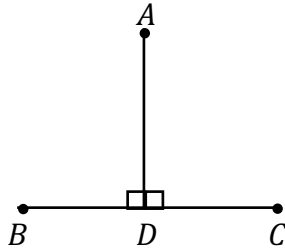

Statement #1:

Reason

Statement #2:

Reason:

Exercise 2: Writing Statements & Reasons

Write the statement (conclusion) and reason for each given diagram below.
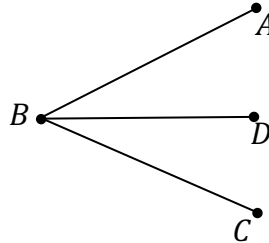
a. Given: $\angle ADB$ and $\angle ADC$ are right angles.

A

B D C

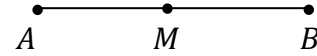Statement:

Reason:

b. Given: $\overline{BD}$ is the angle bisector of $\angle ABC$.

A

B

D

C

Statement:

Reason:
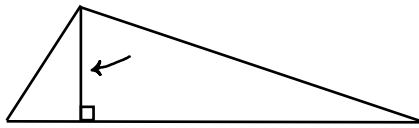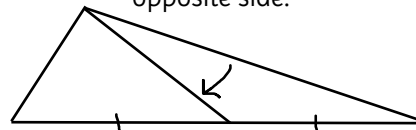
c. Given: M is the midpoint of $\overline{AB}$.

A M B

Statement:

Reason:

Altitude of a Triangle	Median of a Triangle
A segment drawn from a vertex of a triangle to the opposite side to form right angles.	A segment drawn from a vertex of a triangle to the opposite side such that the segment bisects the opposite side.

Skill 3: Median & Altitude

$\overline{YW}$ is the median of ΔXYZ. What can we conclude? Draw an illustration and be sure to explain your resoning.

Exercise 3: Median & Altitude

Given isosceles ΔABC, $\overline{BM}$ is the perpendicular bisector of side $\overline{AC}$ where point M lies on segment $\overline{AC}$.

Is $\overline{BM}$ the altitude, median or both of ΔABC? Draw a picture and explain your reasoning.

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Skill 4: Ordering Statements and Reasons in two columns

Given the diagram, $\overline{AB}$ is the perpendicular bisector of $\overline{CD}$, with E being the intersection point.
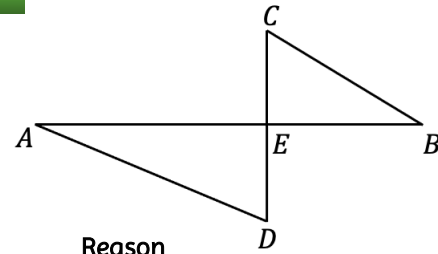
a. List as many statements and reasons that you can given this information and label the diagram. You should always state the given information first and write "Given" as the reason.
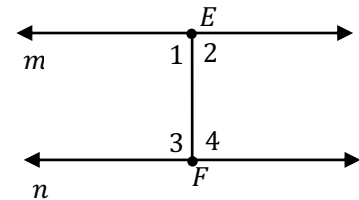
Statement	Reason

b. Can we say that $\overline{CE}$ is the altitude of ΔCEB?

Write It Out

In the diagram below line m and line n are intersected by transversal $\overline{EF}$ to form $\angle 1, \angle 2, \angle 3,$ and $\angle 4$, where $\overline{EF}$ is perpendicular to both lines m and n.

Prove that line m and n are parallel by filling in the missing statements and reasons below.

Statement	Reason
1. Lines m and n are intersected by transversal $\overline{EF}$, such that $\overline{EF}$ is perpendicular to both m and n.	1.
2.	2. Perpendicular Lines form Right Angles.
3. $\angle 1 \cong \angle 2 \cong \angle 3 \cong \angle 4$	3.
4. $\angle 1 \cong \angle 4$	4. Substitution property
5.	5. If two lines are cut by transversal, and alternate interior angles are congruent, then the lines are parallel.

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3.01- Problem Set

Name: _____

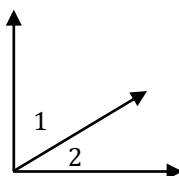1.   Write the statement (conclusion) and reason for each given diagram below.

a.   Given: Lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ intersect at E to form $\angle AED$ and $\angle BEC$.
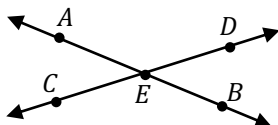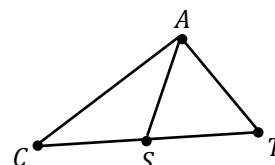
b.   Given: $\angle 1$ and $\angle 2$ are complementary.

c.   Given: $\overline{AS}$ is the median of $\triangle CAT$.

Statement:

Reason:

Statement:

Reason:
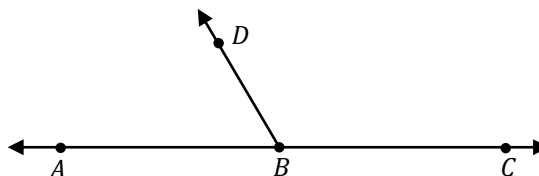
Statement:

Reason:

2.   Segment AB is the perpendicular bisector of $\overline{XY}$ at Z. Which pair of segments does not have to be congruent?

1) $\overline{AZ}, \overline{BZ}$

2) $\overline{XZ}, \overline{YZ}$

3) $\overline{XA}, \overline{YA}$

4) $\overline{XB}, \overline{YB}$

3.   Given $\overleftrightarrow{ABC}$ with $\overrightarrow{BD}$ as shown in the diagram below, what can we conclude?

4.   In the diagram below, K is the midpoint of $\overline{JL}$ and M is the midpoint of $\overline{KL}$. Which of the following statements is true?

1) $\overline{KM} = 2 \cdot \overline{LM}$

2) $\overline{LM} = \frac{1}{2} \cdot \overline{JL}$

3) $\overline{KM} = \frac{1}{4} \cdot \overline{JL}$

4) $\overline{KM} = \frac{1}{2} \cdot \overline{JM}$