# Chapter 1 Line and Angle Relationships

## SECTION 1.1: Sets, Statements, and Reasoning

**1.** **a.** Not a statement.

**b.** Statement; true

**c.** Statement; true

**d.** Statement; false

**2.** **a.** Statement; true

**b.** Not a statement.

**c.** Statement; false

**d.** Statement; false

**3.** **a.** Christopher Columbus did not cross the Atlantic Ocean.

**b.** Some jokes are not funny.

**4.** **a.** Someone likes me.

**b.** Angle 1 is not a right angle.

**5.** Conditional

**6.** Conjunction

**7.** Simple

**8.** Disjunction

**9.** Simple

**10.** Conditional

**11.** H: You go to the game.

C: You will have a great time.

**12.** H: Two chords of a circle have equal lengths.

C: The arcs of the chords are congruent.

**13.** H: The diagonals of a parallelogram are perpendicular.

C: The parallelogram is a rhombus.

**14.** H: $\frac{a}{b} = \frac{c}{d}$ $(b \neq 0,\ d \neq 0)$

C: $a \cdot d = b \cdot c$

**15.** H: Two parallel lines are cut by a transversal.

C: Corresponding angles are congruent.

**16.** H: Two lines intersect.

C: Vertical angles are congruent.

**17.** First, write the statement in "If, then" form. If a figure is a square, then it is a rectangle.

H: A figure is a square.

C: It is a rectangle.

**18.** First, write the statement in "If, then" form. If angles are base angles, then they are congruent.

H: Angles are base angles of an isosceles triangle.

C: They are congruent.

**19.** True

**20.** True

**21.** True

**22.** False

**23.** False

**24.** True

**25.** Induction

**26.** Intuition

**27.** Deduction

**28.** Deduction

**29.** Intuition

**30.** Induction

**31.** None

**32.** Intuition

**33.** Angle 1 looks equal in measure to angle 2.

**34.** $\overline{AM}$ has the same length as $\overline{MB}$.

**35.** Three angles in one triangle are equal in measure to the three angles in the other triangle.

**36.** The angles are not equal in measure.

**37.** *A Prisoner of Society* might be nominated for an Academy Award.

**38.** Andy is a rotten child.

**39.** The instructor is a math teacher.

**40.** Your friend likes fruit.

**41.** Angles 1 and 2 are complementary.

**42.** Kathy Jones will be a success in life.

**43.** Alex has a strange sense of humor.

**44.** None

**45.** None

**46.** None

**47.** June Jesse will be in the public eye.

**48.** None

**49.** Marilyn is a happy person.

**50.** None

**51.** Valid

**52.** Not valid

**53.** Not valid

**54.** Valid

**55.** **a.** True

**b.** True

**c.** False

**56.** **a.** False

**b.** False

**57.** **a.** True

**b.** True

## SECTION 1.2: Informal Geometry and Measurement

**1.** $AB < CD$

**2.** $\text{m}\angle ABC < \text{m}\angle DEF$

**3.** Two; one

**4.** No

**5.** One; none

**6.** Three

**7.** $\angle ABC$, $\angle ABD$, $\angle DBC$

**8.** 23°, 90°, 110.5°

**9.** Yes; no; yes

**10.** *A*-*X*-*B*

**11.** $\angle ABC$, $\angle CBA$

**12.** Yes; yes

**13.** Yes; no

**14.** a, d

**15.** a, d

**16.** *R*; they are equal.

**17.** **a.** 3

**b.** $2\frac{1}{2}$

**18.** **a.** 1.5

**b.** 5

**19.** **a.** 40°

**b.** 50°

**20.** **a.** 90°

**b.** 25°

**21.** Congruent; congruent

**22.** Equal; yes

**23.** Equal

**24.** 2 inches

**25.** No

**26.** Yes

**27.** Yes

**28.** No

**29.** Congruent

**30.** Congruent

**31.** $\overline{MN}$ and $\overline{QP}$

**32.** Equal

**33.** $\overline{AB}$

**34.** $\angle ABD$

**35.** 22

**36.** 14

**37.**
$$\begin{aligned} x + x + 3 &= 21 \\ 2x &= 18 \\ x &= 9 \end{aligned}$$

**38.** $x + y$

**39.** 124°

**40.**
$$\begin{aligned} 2x + x &= 180 \\ 3x &= 180 \\ x &= 60 \\ \text{m}\angle 1 &= 120^\circ \end{aligned}$$

**41.** 71°

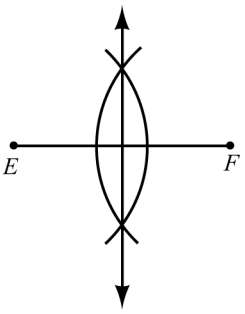
**42.** 34°

**43.**
$$\begin{aligned} x + 2x + 3 &= 72 \\ 3x &= 69 \\ x &= 23 \end{aligned}$$

**44.** $x + y$

**45.** $32.7 \div 3 = 10.9$

**46.**




**47.**
$$\begin{array}{r} x + y = 180 \\ x - y = 24 \\ \hline 2x \quad = 204 \end{array}$$
$$x = 102$$
$$y = 78$$

**48.**
$$\begin{array}{r} x + y = 67 \\ x - y = 17 \\ \hline 2x \quad = 84 \end{array}$$
$$x = 42$$
$$y = 25$$

**49.** N 22° E

**50.** S 66° E

## SECTION 1.3: Early Definitions and Postulates

**1.** $AC$

**2.** Midpoint

**3.** 6.25 ft · 12 in./ft = 75 in.

**4.** 52 in. ÷ 12 in./ft = $4\frac{1}{3}$ ft or 4 ft 4 in.

**5.** $\frac{1}{2}$m · 3.28 ft/m = 1.64 feet

**6.** 16.4 ft ÷ 3.28 ft/m = 5 m

**7.** 18 – 15 = 3 mi

**8.** $300 + 450 + 600 = 1350$ ft
1350 ft ÷ 15 ft/s = 90 s or 1 min 30 s

**9. a.** *A*-*C*-*D*

**b.** *A*, *B*, *C* or *B*, *C*, *D* or *A*, *B*, *D*

**10. a.** Infinite

**b.** One

**c.** None

**d.** None

**11.** $\overleftrightarrow{CD}$ means line *CD*;
$\overline{CD}$ means segment *CD*;
*CD* means the measure or length of $\overline{CD}$;
$\overrightarrow{CD}$ means ray *CD* with endpoint *C*.

**12. a.** No difference

**b.** No difference

**c.** No difference

**d.** $\overrightarrow{CD}$ is the ray starting at *C* and going to the right.
$\overrightarrow{DC}$ is starting at *D* and going to the left.

**13. a.** $m$ and $t$

**b.** $m$ and $p$ or $p$ and $t$

**14. a.** False

**b.** False

**c.** True

**d.** True

**e.** False

**15.**
$$2x + 1 = 3x - 2$$
$$-x = -3$$
$$x = 3$$
$$AM = 7$$

**16.**
$$2(x + 1) = 3(x - 2)$$
$$2x + 2 = 3x - 6$$
$$-1x = -8$$
$$x = 8$$
$$AB = AM + MB$$
$$AB = 18 + 18 = 36$$

**17.**
$$2x + 1 + 3x = 6x - 4$$
$$5x + 3 = 6x - 4$$
$$-1x = -7$$
$$x = 7$$
$$AB = 38$$

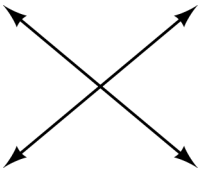
**18.** No; Yes; Yes; No

**19. a.** $\overrightarrow{OA}$ and $\overrightarrow{OD}$

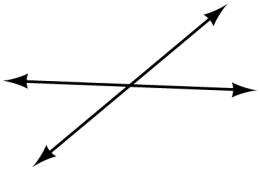
**b.** $\overrightarrow{OA}$ and $\overrightarrow{OB}$ (There are other possible answers.)

**20.** $\overleftrightarrow{CD}$ lies on plane *X*.

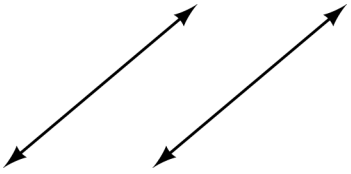
**21. a.**



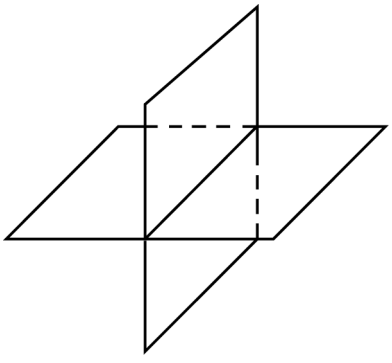
**b.**



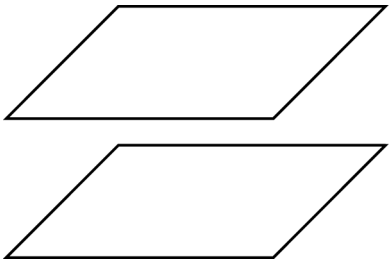
**c.**



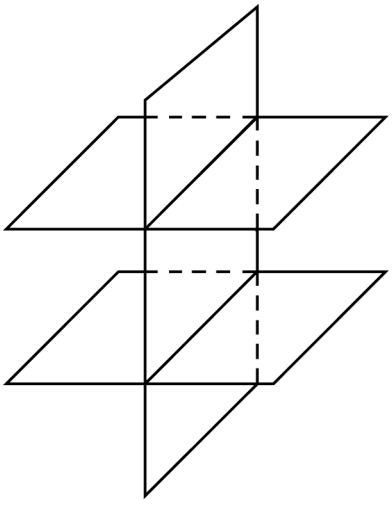
**22. a.**



**b.**



**c.**



**23.** Planes $M$ and $N$ intersect at $\overleftrightarrow{AB}$.

**24.** $B$

**25.** $A$

**26. a.** One

**b.** Infinite

**c.** One

**d.** None

**27. a.** $C$

**b.** $C$

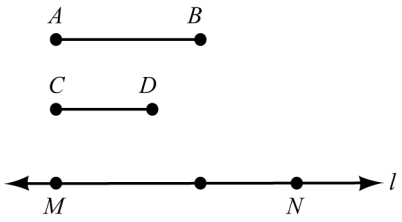
**c.** $H$

**28. a.** Equal

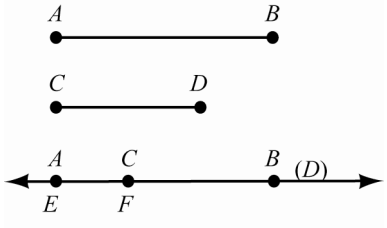
**b.** Equal

**c.** $AC$ is twice $DC$.

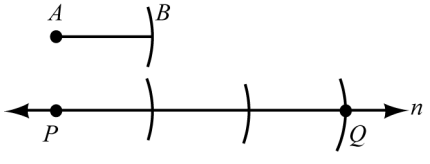
**29.** Given: $\overline{AB}$ and $\overline{CD}$ as shown ($AB > CD$)
Construct $\overline{MN}$ on line $l$ so that
$MN = AB + CD$




**30.** Given: $\overline{AB}$ and $\overline{CD}$ as shown ($AB > CD$)
Construct: $\overline{EF}$ so that $EF = AB - CD$.

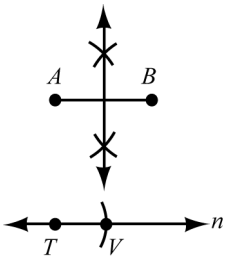



**31.** Given: $\overline{AB}$ as shown
Construct: $\overline{PQ}$ on line $n$ so that $PQ = 3(AB)$



**32.** Given: $\overline{AB}$ as shown

Construct: $\overline{TV}$ on line $n$ so that $TV = \frac{1}{2}(AB)$




**33.** **a.** No

**b.** Yes

**c.** No

**d.** Yes

**34.** A segment can be divided into $2^n$ congruent parts where $n \geq 1$.

**35.** Six

**36.** Four

**37.** Nothing

**38.** **a.** One

**b.** One

**c.** None

**d.** One

**e.** One

**f.** One

**g.** None

**39.** **a.** Yes

**b.** Yes

**c.** No

**40.** **a.** Yes

**b.** No

**c.** Yes

**41.** $\frac{1}{3}a + \frac{1}{2}b$ or $\frac{2a+3b}{6}$

## SECTION 1.4: Angles and Their Relationships

**1.** **a.** Acute

**b.** Right

**c.** Obtuse

**2.** **a.** Obtuse

**b.** Straight

**c.** Acute

**3.** **a.** Complementary

**b.** Supplementary

**4.** **a.** Congruent

**b.** None

**5.** Adjacent

**6.** Vertical

**7.** Complementary (also adjacent)

**8.** Supplementary

**9.** Yes; No

**10.** **a.** True

**b.** False

**c.** False

**d.** False

**e.** True

**11.** **a.** Obtuse

**b.** Straight

**c.** Acute

**d.** Obtuse

**12.** $B$ is not in the interior of $\angle FAE$; the Angle-Addition Postulate does not apply.

**13.** $\text{m}\angle FAC + \text{m}\angle CAD = 180$
$\angle FAC$ and $\angle CAD$ are supplementary.

**14.** **a.** $x + y = 180$

**b.** $x = y$

**15.** **a.** $x + y = 90$

**b.** $x = y$

**16.** 62°

**17.** 42°

**18.** $2x + 9 + 3x - 2 = 67$
$5x + 7 = 67$
$5x = 60$
$x = 12$

**19.** $2x-10+x+6=4(x-6)$
$3x-4=4x-24$
$20=x$
$x=20$
$\text{m}\angle RSV=4(20-6)=56^\circ$

**20.** $5(x+1)-3+4(x-2)+3=4(2x+3)-7$
$5x+5-3+4x-8+3=8x+12-7$
$9x-3=8x+5$
$x=8$
$\text{m}\angle RSV=4(2\cdot 8+3)-7=69^\circ$

**21.** $\frac{x}{2}+\frac{x}{4}=45$

Multiply by LCD, 4

$2x+x=180$

$3x=180$

$x=60;\ \text{m}\angle RST=30^\circ$

**22.** $\frac{2x}{3}+\frac{x}{2}=49$

Multiply by LCD, 6

$4x+3x=294$

$7x=294$

$x=42;\ \text{m}\angle TSV=\frac{x}{2}=21^\circ$

**23.** $x+y=2x-2y$
$x+y+2x-2y=64$

$-1x+3y=0$
$3x-1y=64$

$-3x+9y=0$
$3x-y=64$
$8y=64$
$y=8;\ x=24$

**24.** $2x+3y=3x-y+2$
$2x+3y+3x-y+2=80$

$-1x+4y=2$
$5x+2y=78$

$-5x+20y=10$
$5x+2y=78$
$22y=88$
$y=4;\ x=14$

**25.** $\angle CAB\cong\angle DAB$

**26.** $x+y=90$
$x=12+y$

$x+y=90$
$x-y=12$
$2x=102$
$x=51$
$51+y=90$
$y=39$

**27.** $x+y=180$
$x=24+2y$

$x+y=180$
$x-2y=24$

$-2x+2y=360$
$x-2y=24$
$3x=384$
$x=128;\ y=52$
$\angle$s are 128° and 52°.

**28.** **a.** $(90-x)^\circ$

**b.** $(90-(3x-12))^\circ=(102-3x)^\circ$

**c.** $90-(2x+5y)=(90-2x-5y)^\circ$

**29.** **a.** $(180-x)^\circ$

**b.** $180-(3x-12)=(192-3x)^\circ$

**c.** $180-(2x+5y)$
$(180-2x-5y)^\circ$

**30.** $x-92=92-53$
$x-92=39$
$x=131$

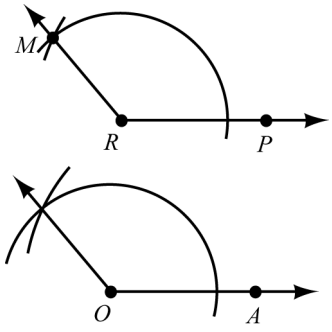
**31.** $x-92+(92-53)=90$
$x-92+39=90$
$x-53=90$
$x=143$

**32.** **a.** True

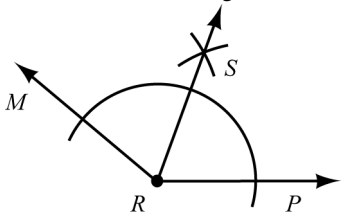
**b.** False

**c.** False

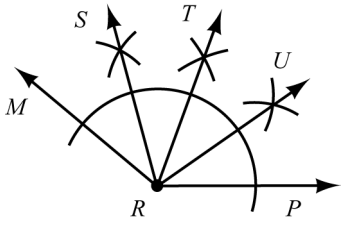
**33.** Given: Obtuse $\angle MRP$
Construct: With $\overrightarrow{OA}$ as one side, an angle $\cong \angle MRP$.



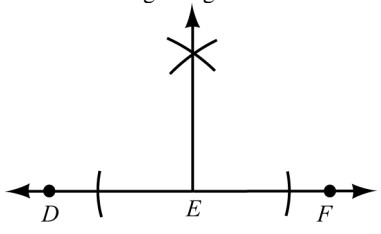

**34.** Given: Obtuse $\angle MRP$
Construct: $\overrightarrow{RS}$, the angle-bisector of $\angle MRP$.



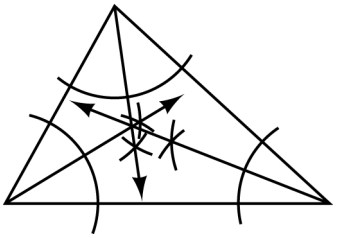

**35.** Given: Obtuse $\angle MRP$
Construct: Rays *RS*, *RT*, and *RU* so that $\angle MRP$ is divided into 4 $\cong$ angles.




**36.** Given: Straight angle *DEF*
Construct: a right angle with vertex at *E*.

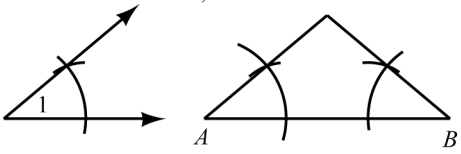



**37.** For the triangle shown, the angle bisectors are been constructed.



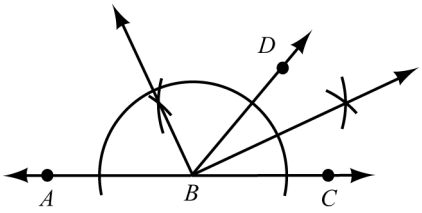
It appears that the angle bisectors meet at one point.

**38.** Given: Acute $\angle 1$
Construct: Triangle *ABC* which has $\angle A \cong \angle 1$, $\angle B \cong \angle 1$ and base $\overline{AB}$.




**39.** It appears that the two sides opposite $\angle$ s *A* and *B* are congruent.

**40.** Given: Straight angle *ABC*
Construct: Bisectors of $\angle ABD$ and $\angle DBC$.




It appears that a right angle is formed.

**41.** **a.** 90°

**b.** 90°

**c.** Equal

**42.** Let m$\angle$ *USV* = *x*, then m$\angle$ TSU = 38 − *x*

$38 - x + 40 = 61$

$78 - x = 61$

$78 - 61 = x$

$x = 17$; m$\angle$ *USV* = 17°

**43.** $x + 2z + x - z + 2x - z = 60$
$4x = 60$
$x = 15$
If $x = 15$, then $m\angle USV = 15 - z$,
$m\angle VSW = 30 - z$, and
$m\angle USW = 3x - 6 = 3(15) - 6 = 39$
So $15 - z + 2(15) - z = 39$
$45 - 2z = 39$
$6 = 2z$
$z = 3$

**44.** **a.** 52°

**b.** 52°

**c.** Equal

**45.** $90 + x + x = 360$
$2x = 270$
$x = 135^\circ$

**46.** 90

## SECTION 1.5: Introduction to Geometric Proof

**1.** Division Property of Equality or Multiplication Property of Equality

**2.** Distributive Property $[x + x = (1+1)x = 2x]$

**3.** Subtraction Property of Equality

**4.** Addition Property of Equality

**5.** Multiplication Property of Equality

**6.** Addition Property of Equality

**7.** If 2 angles are supplementary, then the sum of their measures is 180°.

**8.** If the sum of the measures of 2 angles is 180°, then the angles are supplementary.

**9.** Angle-Addition Property

**10.** Definition of angle-bisector

**11.** $AM + MB = AB$

**12.** $AM = MB$

**13.** $\overrightarrow{EG}$ bisects $\angle DEF$

**14.** $m\angle 1 = m\angle 2$ or $\angle 1 \cong \angle 2$

**15.** $m\angle 1 + m\angle 2 = 90^\circ$

**16.** $\angle 1$ and $\angle 2$ are complementary

**17.** $2x = 10$

**18.** $x = 7$

**19.** $7x + 2 = 30$

**20.** $\frac{1}{2} = 50\%$

**21.** $6x - 3 = 27$

**22.** $x = -20$

**23.** **1.** Given

**2.** Distributive Property

**3.** Addition Property of Equality

**4.** Division Property of Equality

**24.** **1.** Given

**2.** Subtraction Property of Equality

**3.** Division Property of Equality

**25.** **1.** $2(x + 3) - 7 = 11$

**2.** $2x + 6 - 7 = 11$

**3.** $2x - 1 = 11$

**4.** $2x = 12$

**5.** $x = 6$

**26.** **1.** $\frac{x}{5} + 3 = 9$

**2.** $\frac{x}{5} = 6$

**3.** $x = 30$

**27.** **1.** Given

**2.** Segment-Addition Postulate

**3.** Subtraction Property of Equality

**28.** **1.** Given

**2.** The midpoint forms 2 segments of equal measure.

**3.** Segment-Addition Postulate

**4.** Substitution

**5.** Distributive Property

**6.** Multiplication Property of Equality

**29.** **1.** Given

**2.** If an angle is bisected, then the two angles formed are equal in measure.

**3.** Angle-Addition Postulate

**4.** Substitution

**5.** Distribution Property

**6.** Multiplication Property of Equality

**30.** **1.** Given

**2.** Angle-Addition Postulate

**3.** Subtraction Property of Equality

**31.** **S1.** *M-N-P-Q* on $\overline{MQ}$

**R1.** Given

**2.** Segment-Addition Postulate

**3.** Segment-Addition Postulate

**4.** $MN + NP + PQ = MQ$

**32.** **1.** $\angle TSW$ with $\overline{SU}$ and $\overline{SV}$; Given

**2.** Angle-Addition Postulate

**3.** Angle-Addition Postulate

**4.** $\text{m}\angle TSW = \text{m}\angle TSU + \text{m}\angle USV + \text{m}\angle VSW$

**33.** $5 \cdot x + 5 \cdot y = 5(x + y)$

**34.** $5 \cdot x + 7 \cdot x = (5 + 7)x = 12x$

**35.** $(-7)(-2) > 5(-2)$ or $14 > -10$

**36.** $\frac{12}{-4} < \frac{-4}{-4}$ or $-3 < 1$

**37.** **1**. Given

**2.** Addition Property of Equality

**3.** Given

**4.** Substitution

**38.**

| | |
|---|---|
| **1**. $a = b$ | **1**. Given |
| **2.** $a - c = b - c$ | **2**. Subtraction Property of Equality |
| **3.** $c = d$ | **3**. Given |
| **4.** $a - c = b - d$ | **4**. Substitution |

## SECTION 1.6: Relationships: Perpendicular Lines

**1.** **1.** Given

**2.** If 2 $\angle$ s are $\cong$, then they are equal in measure.

**3.** Angle-Addition Postulate

**4.** Addition Property of Equality

**5.** Substitution

**6.** If 2 $\angle$ s are = in measure, then they are $\cong$.

**2.** **1.** Given

**2.** The measure of a straight angle is 180°.

**3.** Angle-Addition Postulate

**4.** Substitution

**5.** Given

**6.** The measure of a right $\angle = 90^\circ$.

**7.** Substitution

**8.** Subtraction Property of Equality

**9.** Angle-Addition Postulate

**10.** Substitution

**11.** If the sum of measures of 2 angles is 90°, then the angles are complementary.

**3.** **1.** $\angle 1 \cong \angle 2$ and $\angle 2 \cong \angle 3$

**2.** $\angle 1 \cong \angle 3$

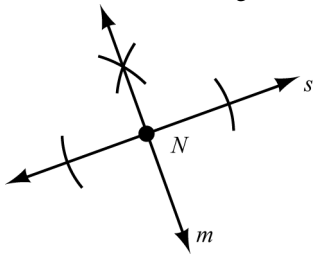
**4.** **1.** $\text{m}\angle AOB = \text{m}\angle 1$ and $\text{m}\angle BOC = \text{m}\angle 1$

**2.** $\text{m}\angle AOB = \text{m}\angle BOC$

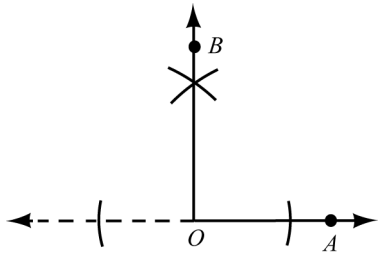
**3.** $\angle AOB \cong \angle BOC$

**4.** $\overrightarrow{OB}$ bisects $\angle AOC$

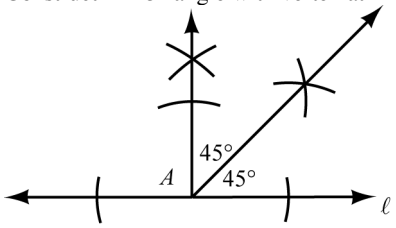
**5.** Given: Point *N* on line *s*.
Construct: Line *m* through *N* so that $m \perp s$.



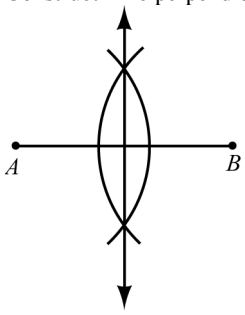

**6.** Given: $\overrightarrow{OA}$
Construct: Right angle *BOA*
(Hint: Use the straightedge to extend $\overrightarrow{OA}$ to the left.)



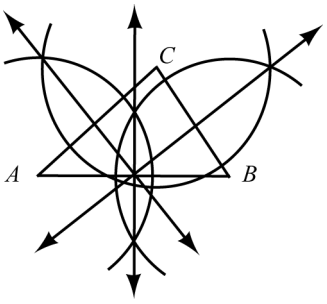
**7.** Given: Line $\ell$ containing point $A$
Construct: A 45° angle with vertex at $A$




**8.** Given: $\overline{AB}$
Construct: The perpendicular bisector of $\overline{AB}$




**9.** Given: Triangle $ABC$
Construct: The perpendicular bisectors of each side, $\overline{AB}$, $\overline{AC}$, and $\overline{BC}$.




**10.** It appears that the perpendicular bisectors meet at one point.

**11.** **1.** Given

**3.** Substitution

**4.** $m\angle 1 = m\angle 2$

**5.** $\angle 1 \cong \angle 2$

**12.** **1.** Given

**2.** $m\angle 1 = m\angle 2$ and $m\angle 3 = m\angle 4$

**3.** Given

**4.** $m\angle 2 + m\angle 3 = 90$

**5.** Substitution

**6.** $\angle$s 1 and 4 are comp.

**13.** No; Yes; No

**14.** No; No; Yes

**15.** No; Yes; No

**16.** No; No; Yes

**17.** No; Yes; Yes

**18.** No; No; No

**19.** **a.** perpendicular

**b.** angles

**c.** supplementary

**d.** right

**e.** measure of angle

**20.** **a**. postulate

**b.** union

**c.** empty set

**d.** less than

**e.** point

**21.** **a**. adjacent

**b.** complementary

**c.** ray AB

**d.** is congruent to

**e.** vertical

**22.** In space, there are an infinite number of lines perpendicular to a given line at a point on the line.

**23.**

| STATEMENTS | REASONS |
|---|---|
| **1.** $M - N - P - Q$ on $\overline{MQ}$ | **1.** Given |
| **2.** $MN + NQ = MQ$ | **2.** Segment-Addition Postulate |
| **3.** $NP + PQ = NQ$ | **3.** Segment-Addition Postulate |
| **4.** $MN + NP + PQ = MQ$ | **4.** Substitution |

**24.** $AE = AB + BC + CD + DE$

**25.**

| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle TSW$ with $\overrightarrow{SU}$ and $\overrightarrow{SV}$ | **1.** Given |
| **2.** $m\angle TSW = m\angle TSU + m\angle USW$ | **2.** Angle-Addition Postulate |
| **3.** $m\angle USW = m\angle USV + m\angle VSW$ | **3.** Angle-Addition Postulate |
| **4.** $m\angle TSW = m\angle TSU + m\angle USV + m\angle VSW$ | **4.** Substitution |

**26.** $m\angle GHK = m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4$

**27.** In space, there are an infinite number of lines that perpendicularly bisect a given line segment at its midpoint.

**28.** **1.** Given

**2.** If 2 $\angle$s are comp., then the sum of their measures is 90°.

**3.** Given

**4.** The measure of an acute angle is between 0 and 90°.

**5.** Substitution

**6.** Subtraction Prop. of Eq.

**7.** Subtraction Prop. of Inequality

**8.** Addition Prop. of Inequality

**9.** Transitive Prop. of Inequality

**10.** Substitution

**11.** If the measure of an angle is between 0 and 90°, then the angle is an acute $\angle$.

**29.** Angles 1, 2, 3, and 4 are adjacent and form the straight angle $AOB$ which measures 180. Therefore, $m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 = 180$.

**30.** If $\angle 2$ and $\angle 3$ are complementary, then $m\angle 2 + m\angle 3 = 90$. From Exercise 29, $m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 = 180$. Therefore, $m\angle 1 + m\angle 4 = 90$ and $\angle 1$ and $\angle 4$ are complementary.

## SECTION 1.7: The Formal Proof of a Theorem

**1.** H: A line segment is bisected.

C: Each of the equal segments has half the length of the original segment.

**2.** H: Two sides of a triangle are congruent.

C: The triangle is isosceles.

**3.** First write the statement in the "If, then" form. If a figure is a square, then it is a quadrilateral.

H: A figure is a square.

C: It is a quadrilateral.

**4.** First write the statement in the "If, then" form. If a polygon is a regular polygon, then it has congruent interior angles.

H: A polygon is a regular polygon.

C: It has congruent interior angles.

**5.** H: Each is a right angle.

C: Two angles are congruent.

**6.** First write the statement in the "If, then" form. If polygons are similar, then the lengths of corresponding sides are proportional.

H: Polygons are similar.

C: The lengths of corresponding sides are proportional.

**7.** Statement, Drawing, Given, Prove, Proof

**8.** **a.** Hypothesis

**b.** Hypothesis

**c.** Conclusion

**9.** **a**. Given **b**. Prove

**10.** *a*, *c*, *d*

**11.** After the theorem has been proved.

**12.** No

**13.** Given: $\overleftrightarrow{AB} \perp \overleftrightarrow{CD}$

Prove: $\angle AEC$ is a right angle.

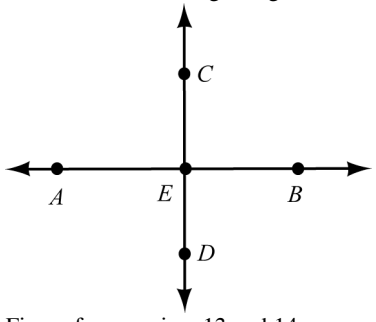


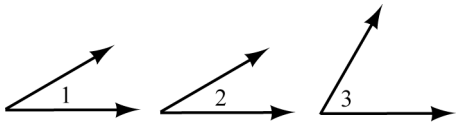

Figure for exercises 13 and 14.

**14.** Given: $\angle AEC$ is a right angle

Prove: $\overleftrightarrow{AB} \perp \overleftrightarrow{CD}$

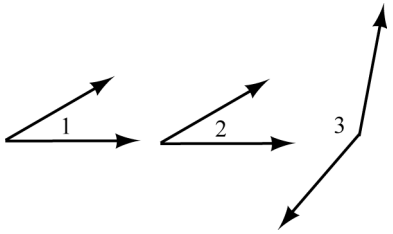
**15.** Given: $\angle 1$ is comp to $\angle 3$
$\angle 2$ is comp to $\angle 3$

Prove: $\angle 1 \cong \angle 2$

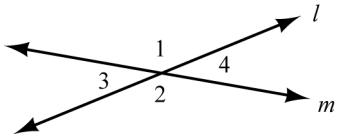



**16.** Given: $\angle 1$ is supp to $\angle 3$
$\angle 2$ is supp to $\angle 3$

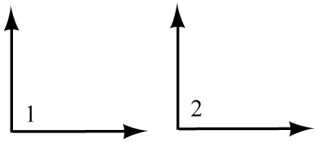
Prove: $\angle 1 \cong \angle 2$



**17.** Given: Lines $l$ and $m$
Prove: $\angle 1 \cong \angle 2$ and $\angle 3 \cong \angle 4$




**18.** Given: $\angle 1$ and $\angle 2$ are right angles
Prove: $\angle 1 \cong \angle 2$




**19.** $m\angle 2 = 55^\circ$, $m\angle 3 = 125^\circ$, $m\angle 4 = 55^\circ$

**20.** $m\angle 1 = 133^\circ$, $m\angle 3 = 133^\circ$, $m\angle 4 = 47^\circ$

**21.** $m\angle 1 = m\angle 3$
$3x + 10 = 4x - 30$
$x = 40;\ m\angle 1 = 130^\circ$

**22.** $m\angle 2 = m\angle 4$
$6x + 8 = 7x$
$x = 8;\ m\angle 2 = 56^\circ$

**23.** $m\angle 1 + m\angle 2 = 180^\circ$
$2x + x = 180$
$3x = 180$
$x = 60;\ m\angle 1 = 120^\circ$

**24.** $m\angle 2 + m\angle 3 = 180^\circ$
$x + 15 + 2x = 180$
$3x = 165$
$x = 55;\ m\angle 2 = 110^\circ$

**25.** $\frac{x}{2} - 10 + \frac{x}{3} + 40 = 180$

$\frac{x}{2} + \frac{x}{3} + 30 = 180$

$\frac{x}{2} + \frac{x}{3} = 150$

Multiply by 6

$3x + 2x = 900$

$5x = 900$

$x = 180;\ m\angle 2 = 80^\circ$

**26.** $x + 20 + \frac{x}{3} = 180$

$x + \frac{x}{3} = 160$

Multiply by 3

$3x + x = 480$

$4x = 480$

$x = 120;\ m\angle 4 = 40^\circ$

**27.** **1.** Given

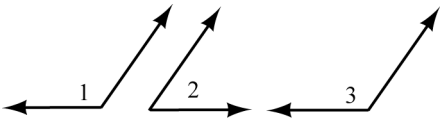
**2.** If 2 $\angle$ s are comp., then the sum of their measures is 90.

**3.** Substitution

**4.** Subtraction Property of Equality

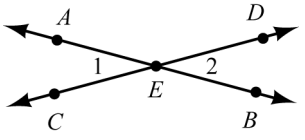
**5.** If 2 $\angle$ s are = in measure, then they are $\cong$.

**28.** Given: $\angle 1$ is supp to $\angle 2$
$\angle 3$ is supp to $\angle 2$
Prove: $\angle 1 \cong \angle 3$



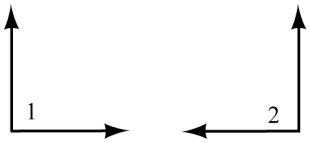

| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle 1$ is supp to $\angle 2$<br>$\angle 3$ is supp to $\angle 2$ | **1.** Given |
| **2.** $m\angle 1 + m\angle 2 = 180$<br>$m\angle 3 + m\angle 2 = 180$ | **2.** If 2 $\angle$s are supp., then the sum of their measures is 180. |
| **3.** $m\angle 1 + m\angle 2$<br>$= m\angle 3 + m\angle 2$ | **3.** Substitution |
| **4.** $m\angle 1 = m\angle 3$ | **4.** Subtraction Property of Equality |
| **5.** $\angle 1 \cong \angle 3$ | **5.** If 2 $\angle$s are = in measure, then they are $\cong$. |

**29.** If 2 lines intersect, the vertical angles formed are congruent.
Given: $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ intersect at $E$
Prove: $\angle 1 \cong \angle 2$




| STATEMENTS | REASONS |
|---|---|
| **1.** $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ intersect at $E$ | **1.** Given |
| **2.** $\angle 1$ is supp to $\angle AED$<br>$\angle 2$ is supp to $\angle AED$ | **2.** If the exterior sides of two adj. $\angle$s form a straight line, then these $\angle$s are supp. |
| **3.** $\angle 1 \cong \angle 2$ | **3.** If 2 $\angle$s are supp. to the same $\angle$, then these $\angle$s are $\cong$. |

**30.** Any two right angles are congruent.
Given: $\angle 1$ is a rt. $\angle$
$\angle 2$ is a rt. $\angle$
Prove: $\angle 1 \cong \angle 2$




| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle 1$ is a rt. $\angle$<br>$\angle 2$ is a rt. $\angle$ | **1.** Given |
| **2.** $m\angle 1 = 90$<br>$m\angle 2 = 90$ | **2.** Measure of a right $\angle = 90$. |
| **3.** $m\angle 1 = m\angle 2$ | **3.** Substitution |
| **4.** $\angle 1 \cong \angle 2$ | **4.** If 2 $\angle$s are = in measure, then they are $\cong$. |

**31.** **1.** Given

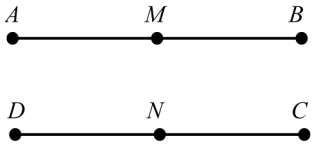
**2.** $\angle ABC$ is a right $\angle$.

**3.** The measure of a rt. $\angle = 90$.

**4.** Angle-Addition Postulate

**6.** $\angle 1$ is comp. to $\angle 2$.

**32.** If 2 segments are congruent, then their midpoints separate these segments into four congruent segments.
Given: $\overline{AB} \cong \overline{DC}$
$M$ is the midpoint of $\overline{AB}$
$N$ is the midpoint of $\overline{DC}$
Prove: $\overline{AM} \cong \overline{MB} \cong \overline{DN} \cong \overline{NC}$




| STATEMENTS | REASONS |
|---|---|
| **1.** $\overline{AB} \cong \overline{DC}$ | **1.** Given |
| **2.** $AB = DC$ | **2.** If 2 segments are $\cong$, then their lengths are =. |
| **3.** $AB = AM + MB$<br>$DC = DN + NC$ | **3.** Segment-Addition Post. |
| **4.** $AM + MB = DN + NC$ | **4.** Substitution |
| **5.** $M$ is the midpt of $\overline{AB}$<br>$N$ is the midpt of $\overline{DC}$ | **5.** Given |
| **6.** $AM = MB$ and<br>$DN = NC$ | **6.** If a pt. is the midpt of a segment, it forms 2 segments equal in measure. |
| **7.** $AM + AM = DN + DN$<br>or $2 \cdot AM = 2 \cdot DN$ | **7.** Substitution |
| **8.** $AM = DN$ | **8.** Division Prop. of Eq. |
| **9.** $AM = MB = DN = NC$ | **9.** Substitution |
| **10.** $\overline{AM} \cong \overline{MB} \cong \overline{DN} \cong \overline{NC}$ | **10.** If segments are = in length, then they are $\cong$. |

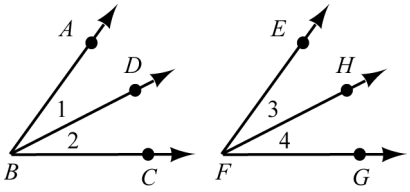
**33.** If 2 angles are congruent, then their bisectors separate these angles into four congruent angles.

Given: $\angle ABC \cong \angle EFG$

$\overrightarrow{BD}$ bisects $\angle ABC$

$\overrightarrow{FH}$ bisects $\angle EFG$

Prove: $\angle 1 \cong \angle 2 \cong \angle 3 \cong \angle 4$




| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle ABC \cong \angle EFG$ | **1.** Given |
| **2.** $m\angle ABC = m\angle EFG$ | **2.** If 2 angles are $\cong$, then their measures are $=$. |
| **3.** $m\angle ABC = m\angle 1 + m\angle 2$<br>$m\angle EFG = m\angle 3 + m\angle 4$ | **3.** Angle-Addition Post. |
| **4.** $m\angle 1 + m\angle 2 = m\angle 3 + m\angle 4$ | **4.** Substitution |
| **5.** $\overrightarrow{BD}$ bisects $\angle ABC$<br>$\overrightarrow{FH}$ bisects $\angle EFG$ | **5.** Given |
| **6.** $m\angle 1 = m\angle 2$ and $m\angle 3 = m\angle 4$ | **6.** If a ray bisects an $\angle$, then 2 $\angle$s of equal measure are formed. |
| **7.** $m\angle 1 + m\angle 1 = m\angle 3 + m\angle 3$ or $2 \cdot m\angle 1 = 2 \cdot m\angle 3$ | **7.** Substitution |
| **8.** $m\angle 1 = m\angle 3$ | **8.** Division Prop. of Eq. |
| **9.** $m\angle 1 = m\angle 2 = m\angle 3 = m\angle 4$ | **9.** Substitution |
| **10.** $\angle 1 \cong \angle 2 \cong \angle 3 \cong \angle 4$ | **10.** If $\angle$s are $=$ in measure, then they are $\cong$. |

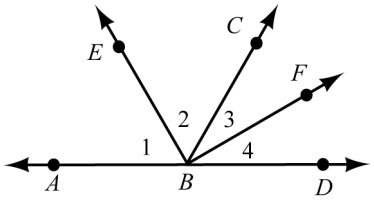
**34.** The bisectors of two adjacent supplementary angles form a right angle.

Given: $\angle ABC$ is supp. to $\angle CBD$

$\overrightarrow{BE}$ bisects $\angle ABC$

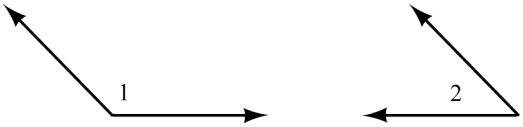
$\overrightarrow{BF}$ bisects $\angle CBD$

Prove: $\angle EBF$ is a rt. $\angle$




| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle ABC$ is supp to $\angle CBD$ | **1.** Given |
| **2.** $m\angle ABC + m\angle CBD = 180$ | **2.** The sum of the measures of supp angles is 180. |
| **3.** $m\angle ABC = m\angle 1 + m\angle 2$<br>$m\angle CBD = m\angle 3 + m\angle 4$ | **3.** Angle-Addition Post. |
| **4.** $m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 = 180$ | **4.** Substitution |
| **5.** $\overrightarrow{BE}$ bisects $\angle ABC$<br>$\overrightarrow{BF}$ bisects $\angle CBD$ | **5.** Given |
| **6.** $m\angle 1 = m\angle 2$ and $m\angle 3 = m\angle 4$ | **6.** If a ray bisects an $\angle$, then 2 $\angle$s of equal measure are formed. |
| **7.** $m\angle 2 + m\angle 2 + m\angle 3 + m\angle 3 = 180$ or $2 \cdot m\angle 2 + 2 \cdot m\angle 3 = 180$ | **7.** Substitution |
| **8.** $m\angle 2 + m\angle 3 = 90$ | **8.** Division Prop. of Eq. |
| **9.** $m\angle EBF = m\angle 2 + m\angle 3$ | **9.** Angle-Addition Post. |
| **10.** $m\angle EBF = 90$ | **10.** Substitution |
| **11.** $\angle EBF$ is a rt. $\angle$ | **11.** If the measure of an $\angle$ is 90, then the $\angle$ is a rt. $\angle$. |

**35.** The supplement of an acute angle is obtuse.
Given: $\angle 1$ is supp to $\angle 2$
$\angle 2$ is an acute $\angle$
Prove: $\angle 1$ is an obtuse $\angle$




| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle 1$ is supp to $\angle 2$ | **1.** Given |
| **2.** $m\angle 1 + m\angle 2 = 180$ | **2.** If 2 $\angle$s are supp., the sum of their measures is 180. |
| **3.** $\angle 2$ is an acute $\angle$ | **3.** Given |
| **4.** $m\angle 2 = x$ where $0 < x < 90$ | **4.** The measure of an acute $\angle$ is between 0 and 90. |
| **5.** $m\angle 1 + x = 180$ | **5.** Substitution (#4 into #3) |
| **6.** $x$ is positive $\therefore m\angle 1 < \angle 180$ | **6.** If $a + p_1 = b$ and $p_1$ is positive, then $a < b$. |
| **7.** $m\angle 1 = 180 - x$ | **7.** Substitution Prop of Eq. (#5) |
| **8.** $-x < 0 < 90 - x$ | **8.** Subtraction Prop of Ineq. (#4) |
| **9.** $90 - x < 90 < 180 - x$ | **9.** Addition Prop. or Ineq. (#8) |
| **10.** $90 - x < 90 < m\angle 1$ | **10.** Substitution (#7 into #9) |
| **11.** $90 < m\angle 1 < 180$ | **11.** Transitive Prop. of Ineq (#6 & #10) |
| **12.** $\angle 1$ is an obtuse $\angle$ | **12.** If the measure of an angle is between 90 and 180, then the $\angle$ is obtuse. |

## CHAPTER REVIEW

**1.** Undefined terms, defined terms, axioms or postulates, theorems

**2.** Induction, deduction, intuition

**3.** **1.** Names the term being defined.

**2.** Places the term into a set or category.

**3.** Distinguishes the term from other terms in the same category.

**4.** Reversible

**4.** Intuition

**5.** Induction

**6.** Deduction

**7.** H: The diagonals of a trapezoid are equal in length.

C: The trapezoid is isosceles.

**8.** H: The parallelogram is a rectangle.

C: The diagonals of a parallelogram are congruent.

**9.** No conclusion

**10.** Jody Smithers has a college degree.

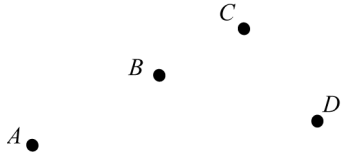
**11.** Angle $A$ is a right angle.

**12.** $C$

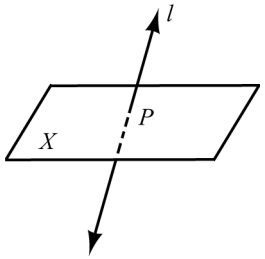
**13.** $\angle RST$ , $\angle S$ , more than 90°.

**14.** Diagonals are $\perp$ and they bisect each other.

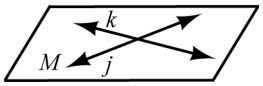
**15.**




**16.**



**17.**




**18.** **a.** Obtuse **b.** Right

**19.** **a.** Acute **b.** Reflex

**20.** $2x+15=3x+5$
$10=x$
$x=10;\ \text{m}\angle ABC=70^\circ$

**21.** $2x+5+3x-4=86$
$5x+1=86$
$5x=85$
$x=17;\ \text{m}\angle DBC=47^\circ$

**22.** $3x-1=4x-5$
$4=x$
$x=4;\ AB=22$

**23.** $4x-4+5x+2=25$
$9x-2=25$
$9x=27$
$x=3;\ MB=17$

**24.** $2\cdot CD=BC$
$2(2x+5)=x+28$
$4x+10=x+28$
$3x=18$
$x=6;\ AC=BC=6+28=34$

**25.** $7x-21=3x+7$
$4x=28$
$x=7$
$\text{m}\angle 3=49-21=28^\circ$
$\therefore \text{m}\angle FMH=180-28=152^\circ$

**26.** $4x+1+x+4=180$
$5x+5=180$
$5x=175$
$x=35$
$\text{m}\angle 4=35+4=39^\circ$

**27.** **a.** Point $M$

**b.** $\angle JMH$

**c.** $\overrightarrow{MJ}$

**d.** $\overleftarrow{KH}$

**28.** $2x-6+3(2x-6)=90$
$2x-6+6x-18=90$
$8x-24=90$
$8x=114$
$x=14\frac{1}{4}$
$\text{m}\angle EFH=3(2x-6)=3\left(28\frac{1}{2}-6\right)$
$=3\cdot 22\frac{1}{2}$
$=67\frac{1}{2}^\circ$

**29.** $x+(40+4x)=180$
$5x+40=180$
$5x=140$
$x=28^\circ$
$40+4x=152^\circ$

**30.** **a.** $2x+3+3x-2+x+7=6x+8$

**b.** $6x+8=32$
$6x=24$
$x=4$

**c.** $2x+3=2(4)+3=11$
$3x-2=3(4)-2=10$
$x+7=4+7=11$

**31.** The measure of angle 3 is less than 50.

**32.** The four foot board is 48 inches. Subtract 6 inches on each end leaving 36 inches.
$4(n-1)=36$
$4n-4=36$
$4n=40$
$n=10$
$\therefore$ 10 pegs will fit on the board.

**33.** S

**34.** S

**35.** A

**36.** S

**37.** N

**38.** **2.** $\angle 4\cong\angle P$

**3.** $\angle 1\cong\angle 4$

**4.** If 2 $\angle$ s are $\cong$, then their measures are =.

**5.** Given

**6.** $\text{m}\angle 2=\text{m}\angle 3$

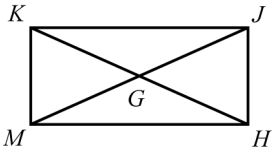
**7.** $\text{m}\angle 1+\text{m}\angle 2=\text{m}\angle 4+\text{m}\angle 3$

**8.** Angle-Addition Postulate

**9.** Substitution

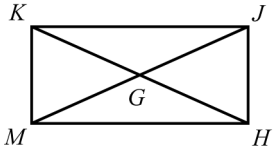
**10.** $\angle TVP\cong\angle MVP$

**39.** Given: $\overline{KF} \perp \overline{FH}$
$\angle JHK$ is a right $\angle$
Prove: $\angle KFH \cong \angle JHF$



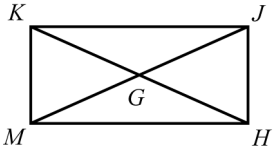

| STATEMENTS | REASONS |
|---|---|
| **1.** $\overline{KF} \perp \overline{FH}$ | **1.** Given |
| **2.** $\angle KFH$ is a right $\angle$ | **2.** If 2 segments are $\perp$, then they form a right $\angle$. |
| **3.** $\angle JHF$ is a right $\angle$ | **3.** Given |
| **4.** $\angle KFH \cong \angle JHF$ | **4.** Any two right $\angle$s are $\cong$. |

**40.** Given: $\overline{KH} \cong \overline{FJ}$
$G$ is the midpoint of both $\overline{KH}$ and $\overline{FJ}$
Prove: $\overline{KG} \cong \overline{GJ}$



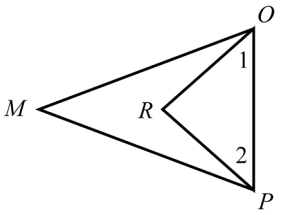

| STATEMENTS | REASONS |
|---|---|
| **1.** $\overline{KH} \cong \overline{FJ}$<br>$G$ is the midpoint of both $\overline{KH}$ and $\overline{FJ}$ | **1.** Given |
| **2.** $\overline{KG} \cong \overline{GJ}$ | **2.** If 2 segments are $\cong$, then their midpoints separate these segments into 4 $\cong$ segments. |

**41.** Given: $\overline{KF} \perp \overline{FH}$
Prove: $\angle KFH$ is comp to $\angle JHF$



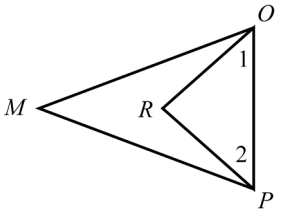

| STATEMENTS | REASONS |
|---|---|
| **1.** $\overline{KF} \perp \overline{FH}$ | **1.** Given |
| **2.** $\angle KFH$ is comp. to $\angle JFH$ | **2.** If the exterior sides of 2 adjacent $\angle$s form $\perp$ rays, then these $\angle$s are comp. |

**42.** Given: $\angle 1$ is comp. to $\angle M$
$\angle 2$ is comp. to $\angle M$
Prove: $\angle 1 \cong \angle 2$



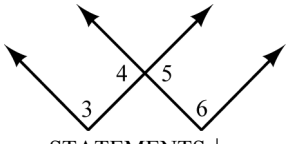

| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle 1$ is comp. to $\angle M$ | **1.** Given |
| **2.** $\angle 2$ is comp. to $\angle M$ | **2.** Given |
| **3.** $\angle 1 \cong \angle 2$ | **3.** If 2 $\angle$s are comp. to the same $\angle$, then these angles are $\cong$. |

**43.** Given: $\angle MOP \cong \angle MPO$
$\overrightarrow{OR}$ bisects $\angle MOP$
$\overrightarrow{PR}$ bisects $\angle MPO$
Prove: $\angle 1 \cong \angle 2$



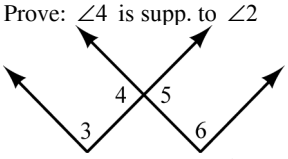

| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle MOP \cong \angle MPO$ | **1.** Given |
| **2.** $\overrightarrow{OR}$ bisects $\angle MOP$<br>$\overrightarrow{PR}$ bisects $\angle MPO$ | **2.** Given |
| **3.** $\angle 1 \cong \angle 2$ | **3.** If 2 $\angle$s are $\cong$, then their bisectors separate these $\angle$s into four $\cong$ $\angle$s. |

**44.** Given: $\angle 4 \cong \angle 6$
Prove: $\angle 5 \cong \angle 6$



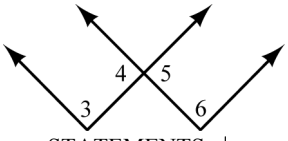

| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle 4 \cong \angle 6$ | **1.** Given |
| **2.** $\angle 4 \cong \angle 5$ | **2.** If 2 angles are vertical $\angle$s then they are $\cong$. |
| **3.** $\angle 5 \cong \angle 6$ | **3.** Transitive Prop. |

**45.** Given: Figure as shown
Prove: $\angle 4$ is supp. to $\angle 2$



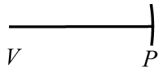

| STATEMENTS | REASONS |
|---|---|
| **1.** Figure as shown | **1.** Given |
| **2.** $\angle 4$ is supp. to $\angle 2$ | **2.** If the exterior sides of 2 adjacent $\angle$s form a line, then the $\angle$s are supp. |

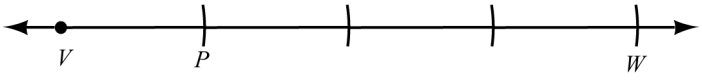
**46.** Given: $\angle 3$ is supp. to $\angle 5$
$\angle 4$ is supp. to $\angle 6$
Prove: $\angle 3 \cong \angle 6$



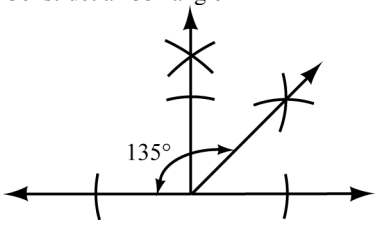

| STATEMENTS | REASONS |
|---|---|
| **1.** $\angle 3$ is supp to $\angle 5$<br>$\angle 4$ is supp to $\angle 6$ | **1.** Given |
| **2.** $\angle 4 \cong \angle 5$ | **2.** If 2 lines intersect, the vertical angles formed are $\cong$. |
| **3.** $\angle 3 \cong \angle 6$ | **3.** If 2 $\angle$s are supp to congruent angles, then these angles are $\cong$. |

**47.** Given: $\overline{VP}$
Construct: $\overline{VW}$ such that $VW = 4 \cdot VP$

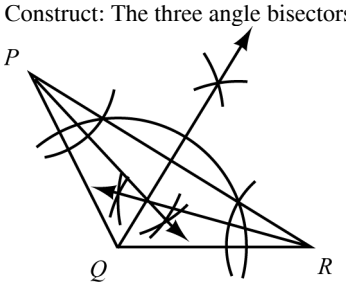



**48.** Construct a 135° angle.

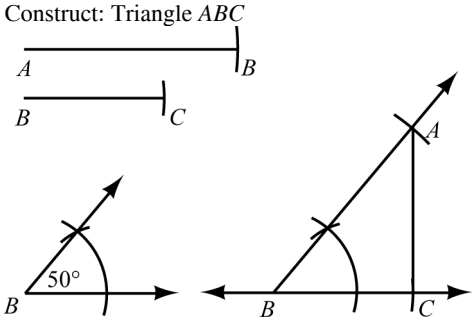


**49.** Given: Triangle $PQR$
Construct: The three angle bisectors.

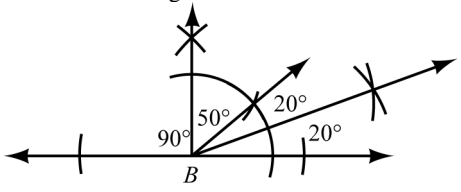



It appears that the three angle bisectors meet at one point inside the triangle.

**50.** Given: $\overline{AB}$, $\overline{BC}$, and $\angle B$ as shown
Construct: Triangle $ABC$




**51.** Given: $m\angle B = 50^\circ$
Construct: An angle whose measure is 20°.




**52.** $m\angle 2 = 270^\circ$

## CHAPTER TEST

**1.** Induction

**2.** $\angle CBA$ or $\angle B$

**3.** $\overline{AP} + \overline{PB} = \overline{AB}$

**4. a.** Point

**b.** Line

**5. a.** Right

**b.** Obtuse

**6. a.** Supplementary

**b.** Congruent

**7.** $m\angle MNP = m\angle PNQ$

**8. a.** Right

**b.** Supplementary

**9.** Kianna will develop reasoning skills.

**10.** $3.2 + 7.2 = 10.4$ in.

**11. a.**
$$\begin{aligned} x + x + 5 &= 27 \\ 2x + 5 &= 27 \\ 2x &= 22 \\ x &= 11 \end{aligned}$$

**b.** $x + 5 = 11 + 5 = 16$

**12.** $m\angle 4 = 35^\circ$

**13. a.**
$$\begin{aligned} x + 2x - 3 &= 69 \\ 3x - 3 &= 69 \\ 3x &= 72 \\ x &= 24^\circ \end{aligned}$$

**b.** $m\angle 4 = 2(24) - 3 = 45^\circ$

**14. a.** $m\angle 2 = 137^\circ$

**b.** $m\angle 2 = 43^\circ$

**15. a.**
$$\begin{aligned} 2x - 3 &= 3x - 28 \\ x &= 25^\circ \end{aligned}$$

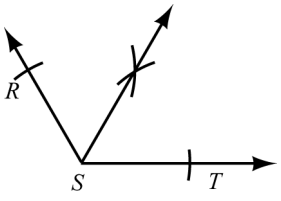
**b.** $m\angle 1 = 3(25) - 28 = 47^\circ$

**16. a.**
$$\begin{aligned} 2x - 3 + 6x - 1 &= 180 \\ 8x - 4 &= 180 \\ 8x &= 184 \\ x &= 23^\circ \end{aligned}$$

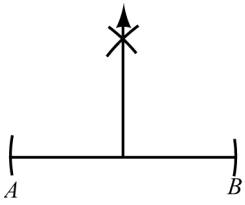
**b.** $m\angle 2 = 6(23) - 1 = 137^\circ$

**17.** $x + y = 90$

**18.**




**19.**



**20.** **1.** Given

**2.** Segment-Addition Postulate

**3.** Segment-Addition Postulate

**4.** Substitution

**21.** **1.** $2x - 3 = 17$

**2.** $2x = 20$

**3.** $x = 10$

**22.** **1.** Given

**2.** 90°

**3.** Angle-Addition Postulate

**4.** 90°

**5.** Given

**6.** Definition of Angle-Bisector

**7.** Substitution

**8.** $m\angle 1 = 45^\circ$

**23.** $108^\circ$