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°

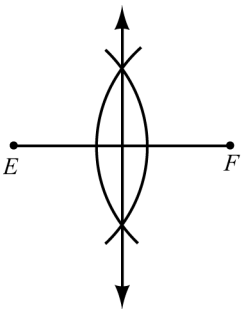
42. 34°

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

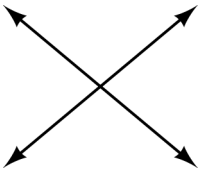
18. No; Yes; Yes; No

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

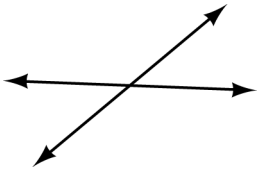
b. $\overrightarrow{OA}$ and $\overrightarrow{OB}$ (There are other possible answers.)

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

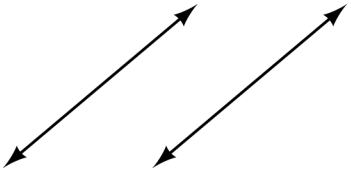
21. a.



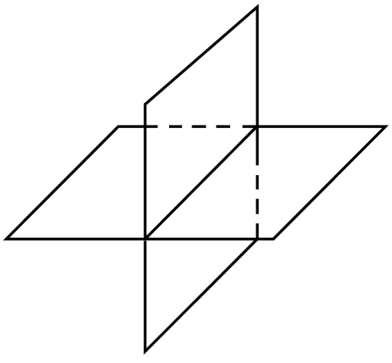
b.



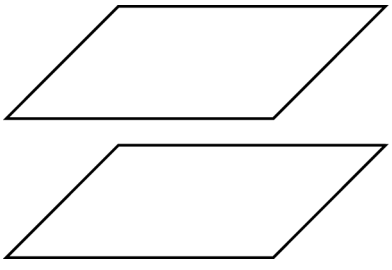
c.



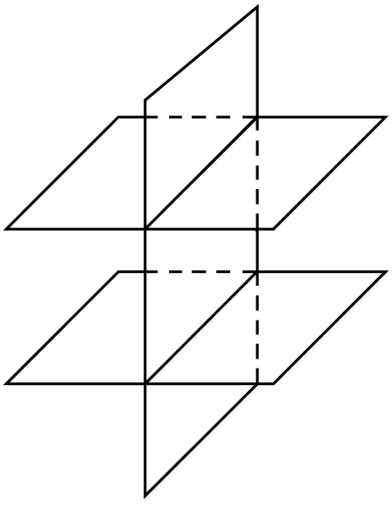
22. a.



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

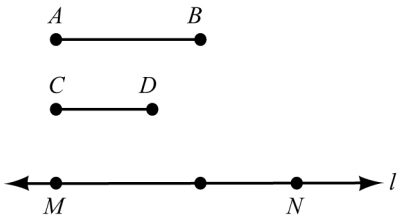
c. H

28. a. Equal

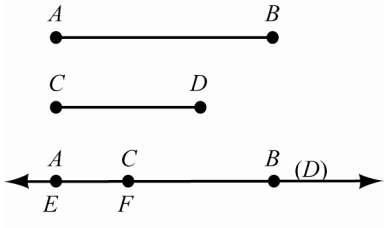
b. Equal

c. AC is twice DC.

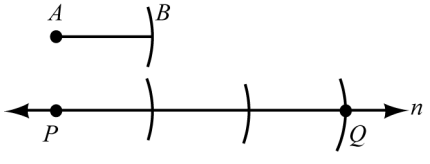
29. Given: $\overline{AB}$ and $\overline{CD}$ as shown ($AB > CD$)
Construct $\overline{MN}$ on line l so that
$MN = AB + CD$



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

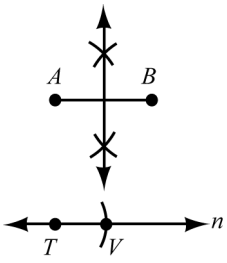


31. Given: $\overline{AB}$ as shown
Construct: $\overline{PQ}$ on line n so that $PQ = 3(AB)$



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

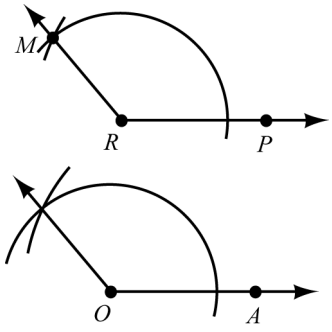
31. $x-92+(92-53)=90$
$x-92+39=90$
$x-53=90$
$x=143$

32. **a.** True

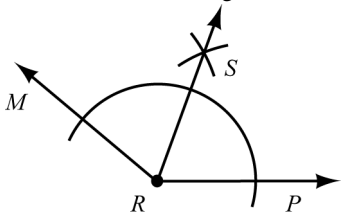
b. False

c. False

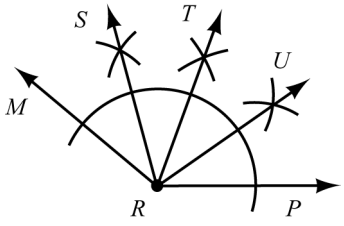
33. Given: Obtuse $\angle MRP$
Construct: With $\overrightarrow{OA}$ as one side, an angle $\cong \angle MRP$.



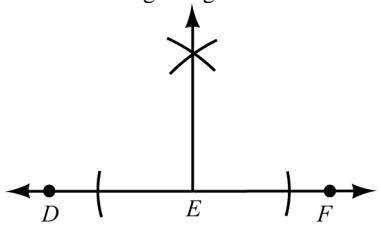
34. Given: Obtuse $\angle MRP$
Construct: $\overrightarrow{RS}$, the angle-bisector of $\angle MRP$.



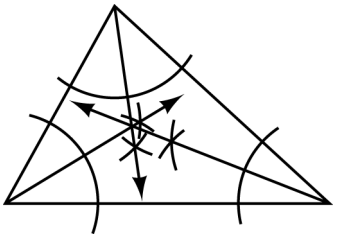
35. Given: Obtuse $\angle MRP$
Construct: Rays *RS*, *RT*, and *RU* so that $\angle MRP$ is divided into 4 $\cong$ angles.



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

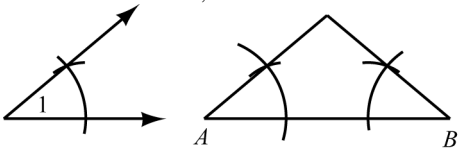


37. For the triangle shown, the angle bisectors are been constructed.



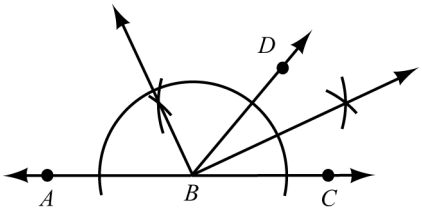
It appears that the angle bisectors meet at one point.

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. $\angle 1 \cong \angle 3$

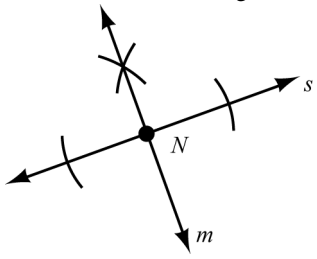
4. **1.** $\text{m}\angle AOB = \text{m}\angle 1$ and $\text{m}\angle BOC = \text{m}\angle 1$

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

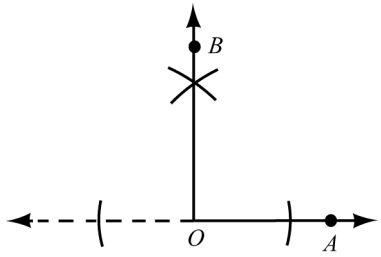
3. $\angle AOB \cong \angle BOC$

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

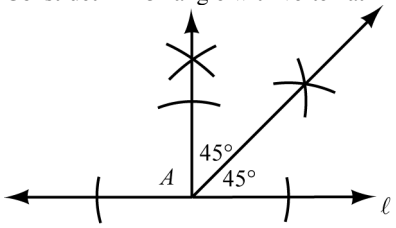
5. Given: Point *N* on line *s*.
Construct: Line *m* through *N* so that $m \perp s$.



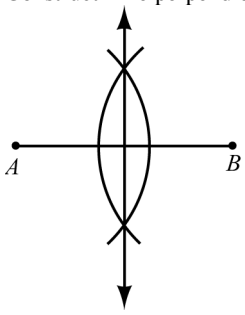
6. Given: $\overrightarrow{OA}$
Construct: Right angle *BOA*
(Hint: Use the straightedge to extend $\overrightarrow{OA}$ to the left.)



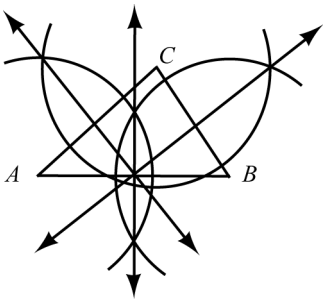
7. Given: Line ℓ containing point A
Construct: A 45° angle with vertex at A



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.

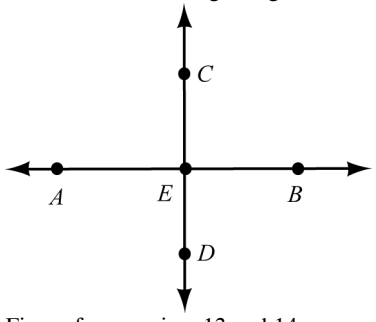


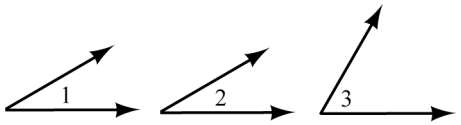
Figure for exercises 13 and 14.

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

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

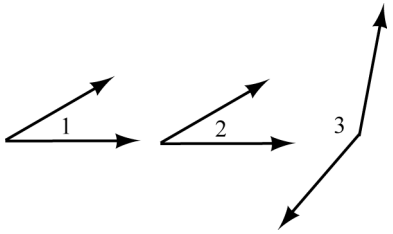
15. Given: $\angle 1$ is comp to $\angle 3$
$\angle 2$ is comp to $\angle 3$

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

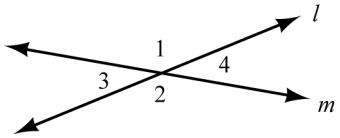


16. Given: $\angle 1$ is supp to $\angle 3$
$\angle 2$ is supp to $\angle 3$

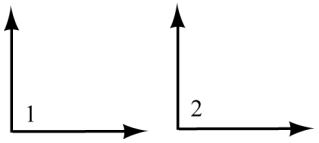
Prove: $\angle 1 \cong \angle 2$



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

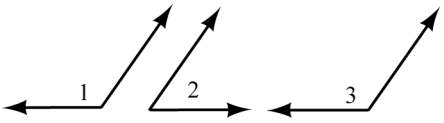
2. If 2 $\angle$ s are comp., then the sum of their measures is 90.

3. Substitution

4. Subtraction Property of Equality

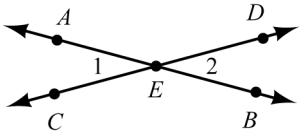
5. If 2 $\angle$ s are = in measure, then they are $\cong$.

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



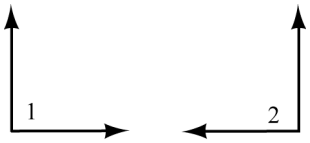
STATEMENTS	REASONS
1. $\angle 1$ is supp to $\angle 2$ $\angle 3$ is supp to $\angle 2$	**1.** Given
2. $m\angle 1 + m\angle 2 = 180$ $m\angle 3 + m\angle 2 = 180$	**2.** If 2 $\angle$s are supp., then the sum of their measures is 180.
3. $m\angle 1 + m\angle 2$ $= m\angle 3 + m\angle 2$	**3.** Substitution
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 $\angle AED$ $\angle 2$ 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. $\angle$ $\angle 2$ is a rt. $\angle$	**1.** Given
2. $m\angle 1 = 90$ $m\angle 2 = 90$	**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

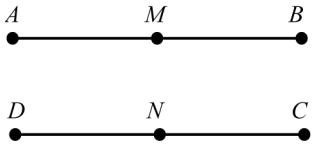
2. $\angle ABC$ is a right $\angle$.

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. $AB = AM + MB$ $DC = DN + NC$	**3.** Segment-Addition Post.
4. $AM + MB = DN + NC$	**4.** Substitution
5. M is the midpt of $\overline{AB}$ N is the midpt of $\overline{DC}$	**5.** Given
6. $AM = MB$ and $DN = NC$	**6.** If a pt. is the midpt of a segment, it forms 2 segments equal in measure.
7. $AM + AM = DN + DN$ 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 $\cong$.

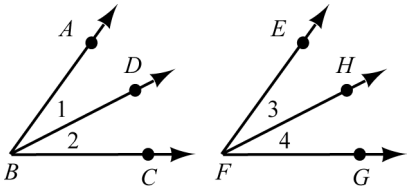
33. If 2 angles are congruent, then their bisectors separate these angles into four congruent angles.

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. $m\angle ABC = m\angle 1 + m\angle 2$ $m\angle EFG = m\angle 3 + m\angle 4$	**3.** Angle-Addition Post.
4. $m\angle 1 + m\angle 2 = m\angle 3 + m\angle 4$	**4.** Substitution
5. $\overrightarrow{BD}$ bisects $\angle ABC$ $\overrightarrow{FH}$ 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 $\cong$.

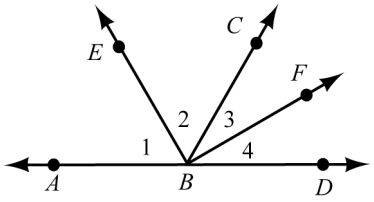
34. The bisectors of two adjacent supplementary angles form a right angle.

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

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

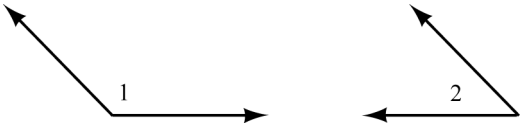
$\overrightarrow{BF}$ bisects $\angle CBD$

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. $m\angle ABC = m\angle 1 + m\angle 2$ $m\angle CBD = m\angle 3 + m\angle 4$	**3.** Angle-Addition Post.
4. $m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 = 180$	**4.** Substitution
5. $\overrightarrow{BE}$ bisects $\angle ABC$ $\overrightarrow{BF}$ 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.

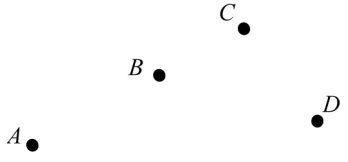
11. Angle A is a right angle.

12. C

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

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

15.



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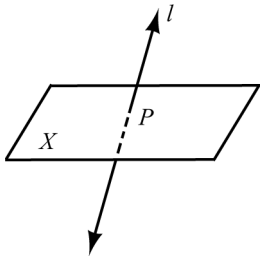

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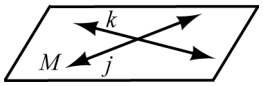


18. **a.** Obtuse **b.** Right

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

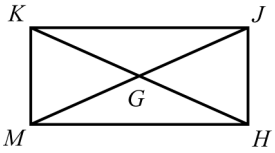
7. $\text{m}\angle 1+\text{m}\angle 2=\text{m}\angle 4+\text{m}\angle 3$

8. Angle-Addition Postulate

9. Substitution

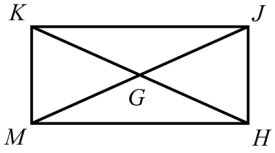
10. $\angle TVP\cong\angle MVP$

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



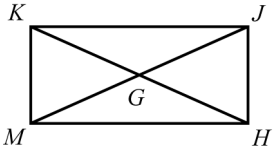
STATEMENTS	REASONS
1. $\overline{KF} \perp \overline{FH}$	**1.** Given
2. $\angle KFH$ is a right $\angle$	**2.** If 2 segments are $\perp$, then they form a right $\angle$.
3. $\angle JHF$ is a right $\angle$	**3.** Given
4. $\angle KFH \cong \angle JHF$	**4.** Any two right $\angle$s are $\cong$.

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



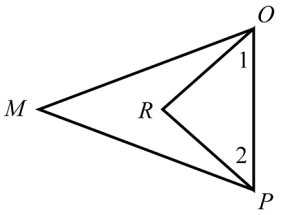
STATEMENTS	REASONS
1. $\overline{KH} \cong \overline{FJ}$ G is the midpoint of both $\overline{KH}$ and $\overline{FJ}$	**1.** Given
2. $\overline{KG} \cong \overline{GJ}$	**2.** If 2 segments are $\cong$, then their midpoints separate these segments into 4 $\cong$ segments.

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



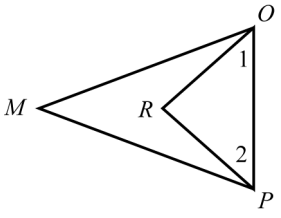
STATEMENTS	REASONS
1. $\overline{KF} \perp \overline{FH}$	**1.** Given
2. $\angle KFH$ is comp. to $\angle JFH$	**2.** If the exterior sides of 2 adjacent $\angle$s form $\perp$ rays, then these $\angle$s are comp.

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



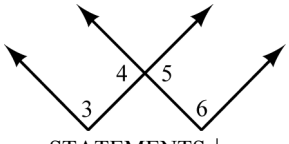
STATEMENTS	REASONS
1. $\angle 1$ is comp. to $\angle M$	**1.** Given
2. $\angle 2$ is comp. to $\angle M$	**2.** Given
3. $\angle 1 \cong \angle 2$	**3.** If 2 $\angle$s are comp. to the same $\angle$, then these angles are $\cong$.

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



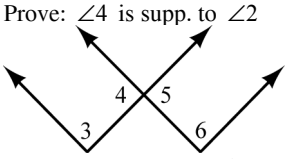
STATEMENTS	REASONS
1. $\angle MOP \cong \angle MPO$	**1.** Given
2. $\overrightarrow{OR}$ bisects $\angle MOP$ $\overrightarrow{PR}$ bisects $\angle MPO$	**2.** Given
3. $\angle 1 \cong \angle 2$	**3.** If 2 $\angle$s are $\cong$, then their bisectors separate these $\angle$s into four $\cong$ $\angle$s.

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



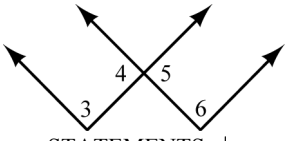
STATEMENTS	REASONS
1. $\angle 4 \cong \angle 6$	**1.** Given
2. $\angle 4 \cong \angle 5$	**2.** If 2 angles are vertical $\angle$s then they are $\cong$.
3. $\angle 5 \cong \angle 6$	**3.** Transitive Prop.

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



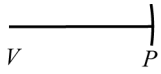
STATEMENTS	REASONS
1. Figure as shown	**1.** Given
2. $\angle 4$ is supp. to $\angle 2$	**2.** If the exterior sides of 2 adjacent $\angle$s form a line, then the $\angle$s are supp.

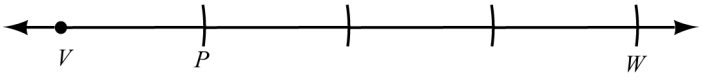
46. Given: $\angle 3$ is supp. to $\angle 5$
$\angle 4$ is supp. to $\angle 6$
Prove: $\angle 3 \cong \angle 6$



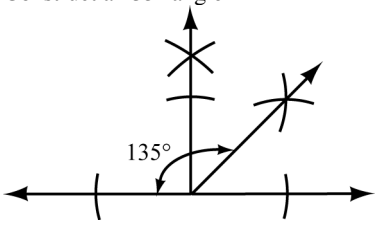
STATEMENTS	REASONS
1. $\angle 3$ is supp to $\angle 5$ $\angle 4$ is supp to $\angle 6$	**1.** Given
2. $\angle 4 \cong \angle 5$	**2.** If 2 lines intersect, the vertical angles formed are $\cong$.
3. $\angle 3 \cong \angle 6$	**3.** If 2 $\angle$s are supp to congruent angles, then these angles are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

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

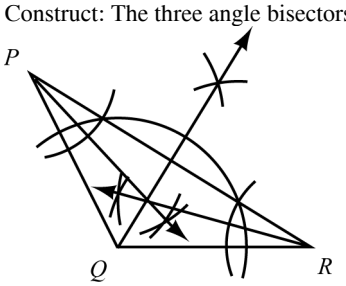




48. Construct a 135° angle.

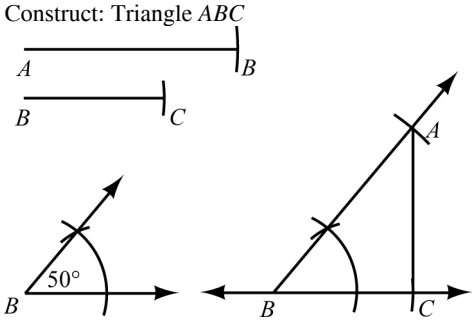


49. Given: Triangle PQR
Construct: The three angle bisectors.

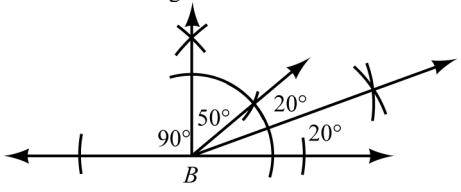


It appears that the three angle bisectors meet at one point inside the triangle.

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

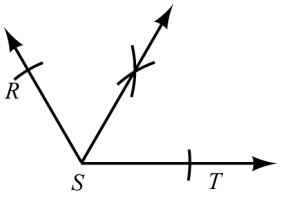
b. $m\angle 1 = 3(25) - 28 = 47^\circ$

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

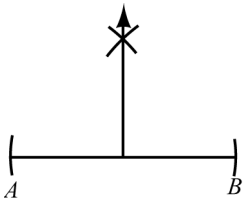
b. $m\angle 2 = 6(23) - 1 = 137^\circ$

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°