CHAPTER 3

Chapter Opener

Chapter Readiness Quiz (p. 106)
1. B
2. H; \( m\angle 7 + m\angle 8 = 180^\circ \)
   \( 68^\circ + m\angle 8 = 180^\circ \)
   \( m\angle 8 = 112^\circ \)
3. D; \( 5x + 9 = 6x - 11 \)
   \( 5x + 9 - 5x = 6x - 11 - 5x \)
   \( 9 = x - 11 \)
   \( 9 + 11 = x - 11 + 11 \)
   \( 20 = x \)

Lesson 3.1

3.1 Activity (p. 107)
1. \( \overrightarrow{AD} \) and \( \overrightarrow{CG} \) will not intersect in space.
2. a. \( \overrightarrow{BC} \) will not intersect \( \overrightarrow{AE} \).
   b. \( \overrightarrow{GH} \) will intersect \( \overrightarrow{DH} \).
   c. \( \overrightarrow{CD} \) will intersect \( \overrightarrow{DH} \).
   d. \( \overrightarrow{AB} \) will not intersect \( \overrightarrow{EH} \).

3.1 Checkpoint (p. 109)
1. line \( x \) and line \( y \)
2. line \( x \) and line \( z \)
3. line \( y \) and line \( z \)
4. \( \overrightarrow{QU}, \overrightarrow{TX}, \overrightarrow{RQ}, \) or \( \overrightarrow{ST} \)
5. plane \( RST \)
6. \( \overrightarrow{SW}, \overrightarrow{RV}, \overrightarrow{QU}, \) or \( \overrightarrow{TX} \)

3.1 Guided Practice (p. 110)
1. Skew lines and parallel lines are alike because they do not intersect. Skew lines are different than parallel lines because skew lines do not lie in the same plane and parallel lines do.
2. line \( k \perp \) line \( m \)
3. line \( m \parallel \) line \( f \)
4. line \( k \perp \) line \( j \)
5. line \( k \parallel \) line \( j \)

3.1 Practice and Applications (pp. 110–113)
9. neither 10. perpendicular 11. parallel
12. Line \( u \) and line \( w \) are not skew lines because they intersect.
13. Line \( m \) and line \( n \) are skew lines because they do not intersect and they do not lie in the same plane.
14. Line \( j \) and line \( k \) are skew lines because they do not intersect and they do not lie in the same plane.
15. \( \overrightarrow{DE}, \overrightarrow{AB}, \) and \( \overrightarrow{GC} \) appear to be parallel.
16. \( \overrightarrow{DE} \) and \( \overrightarrow{BE} \) are perpendicular.
17. \( \overrightarrow{BE} \) and \( \overrightarrow{GC} \) are skew.
18. \( \overrightarrow{BE} \) is perpendicular to plane \( DEF \).
19. Plane \( GAD \) and plane \( CBE \) appear to be parallel.
20. skew 21. \( \overrightarrow{UV}, \overrightarrow{TS}, \) or \( \overrightarrow{WX} \) 22. \( \overrightarrow{QU} \)
23. \( \overrightarrow{XT}, \overrightarrow{SW}, \overrightarrow{VW}, \) or \( \overrightarrow{UX} \) 24. plane \( UVW \)

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Geometry, Concepts and Skills
Chapter 3 Worked-Out Solution Key 37
39. Two skew lines are never parallel.
40. Two perpendicular lines always intersect.
41. Two skew lines are never coplanar.

3.1 Standardized Test Practice (p. 113)
42. D 43. H

3.1 Mixed Review (p. 113)
44. Hypothesis: the band plays
   Conclusion: each member gets $50
45. Hypothesis: $m \angle 5 = 120^\circ$
   Conclusion: $\angle 5$ is obtuse
46. Hypothesis: there is a sale
   Conclusion: the store will be crowded
47. Hypothesis: we can get tickets
   Conclusion: we’ll go to the movies
48. $\angle XYZ \equiv \angle YXZ$ 49. If $\angle 1 \equiv \angle 2$, then $\angle 2 \equiv \angle 1$.
50. If $\overline{AB} \equiv \overline{EF}$ and $\overline{EF} \equiv \overline{ST}$, then $\overline{AB} \equiv \overline{ST}$.

3.1 Algebra Skills (p. 113)
51. $\frac{1}{26}$ 52. $\frac{1}{7}$ 53. $\frac{1}{10}$ 54. $\frac{8}{3}$
55. $18 + (-3) = 15$ 56. $-4 \div 2 = -2$
57. $17 + (-6) = 11$ 58. $16 - (-5) = 21$
59. $-5 + 31 = 26$ 60. $24 - 28 = -4$
61. $(-8)(-10) = 80$ 62. $-25 - 19 = -44$

3.2 Guided Practice (p. 117)
1. If two lines intersect to form adjacent congruent angles, then the lines are perpendicular.
2. If two lines are perpendicular, then they intersect to form four right angles.
3. If two lines intersect to form adjacent congruent angles, then the lines are perpendicular.
4. If two sides of adjacent acute angles are perpendicular, then the angles are complementary.
5. $x^\circ = 90^\circ$ 6. $x^\circ + 45^\circ = 90^\circ$ 7. $70^\circ + x^\circ = 90^\circ$

3.2 Practice and Applications (pp. 117–120)
8. Yes, enough information is given. Both angles are right angles. By Theorem 3.1, they are congruent.
9. Not enough information is given to conclude that $\angle 6 \equiv \angle 7$.
10. Yes, enough information is given. Lines $c$ and $d$ are perpendicular and by Theorem 3.2, perpendicular lines intersect to form four right angles. By Theorem 3.1, all right angles are congruent.
11. Yes, enough information is given. Lines $c$ and $d$ are perpendicular. So, by Theorem 3.2, $\angle 1$ is a right angle. By Theorem 3.1, all right angles are congruent.
12. Sample answer: $m\angle 1 + m\angle 2 = 90^\circ$
13. Sample answer: $m\angle 1 = m\angle 2 = 90^\circ$
14. Sample answer: $m\angle 1 + m\angle 2 = 90^\circ$
Chapter 3 continued

15. The equation should be \((x + 4)^\circ + 56^\circ = 90^\circ\).

16. The equation should be \(9x^\circ = 90^\circ\).

17. \(x = 90\)

18. \(60^\circ + x^\circ = 90^\circ\)  
\[
x = 30
\]

19. \(x^\circ + 55^\circ = 90^\circ\)  
\[
x = 35
\]

20. \((2x + 20)^\circ = 90^\circ\)  
\[
2x = 70
3x = 45
x = 35
x = 15
\]

21. \((3x + 5)^\circ + 40^\circ = 90^\circ\)  
\[
2x = 70
3x = 45
x = 35
x = 15
\]

22. \((5x)^\circ + (10x)^\circ = 90^\circ\)  
\[
15x = 90
x = 6
\]

23. \((2x)^\circ + (7x)^\circ = 90^\circ\)  
\[
9x = 90
x = 10;
\]
\[
m\angle CBD = \frac{(7x)^\circ}{(7(10))^\circ} = 70^\circ
\]

24. \((10x)^\circ + (8x)^\circ = 90^\circ\)  
\[
18x = 90
x = 5;
\]
\[
m\angle CBD = \frac{(8x)^\circ}{(8(5))^\circ} = 40^\circ
\]

25. \((x + 20)^\circ + x^\circ = 90^\circ\)  
\[
2x = 70
x = 35;
\]
\[
m\angle CBD = \frac{x^\circ}{35^\circ}
\]

26. No. Sample answer: If you measure one of the angles and it is \(90^\circ\) then you know that the crosspieces are perpendicular so all 4 angles are right angles.

27. No. Even though \(\angle 1 \equiv \angle 3\) and \(\angle 1 \equiv \angle 3\) are complementary, there is no way of knowing that \(m\angle 2 = m\angle 3 = 90^\circ\).

28. \(\overline{WE} \perp \overline{NS}\); if two lines intersect to form adjacent congruent angles, then the lines are perpendicular.

29. \(90^\circ - 40^\circ = 50^\circ\)  
30. \(180^\circ - 40^\circ = 140^\circ\)

31. Yes; \(\overrightarrow{BF} \perp \overrightarrow{DH}\) and \(\angle DJE\) and \(\angle EJF\) are adjacent acute angles. So, \(m\angle DJE + m\angle EJF = 90^\circ\).

32. \(m\angle BJC = m\angle CJD\)  
\[
m\angle BJC + m\angle CJD = 90^\circ
m\angle BJC + m\angle BJC = 90^\circ
2(m\angle BJC) = 90^\circ
m\angle BJC = 45^\circ
m\angle CJD = m\angle BJC = 45^\circ
\]

33. Not enough information is given to determine that \(\angle AJG\) is a right angle.

3.2 Standardized Test Practice (p. 119)

34. B  35. G; \(90^\circ - 40^\circ = 50^\circ\)

3.2 Mixed Review (p. 120)

36. obtuse; about \(140^\circ\)  
37. acute; about \(80^\circ\)

38. right; about \(90^\circ\)

39. \(m\angle A + m\angle B = 90^\circ\)  
40. \(m\angle C + m\angle D = 180^\circ\)

41. \(4x + 20)^\circ = 80^\circ\)  
42. \(9x = 30 = 150\)

43. \((10x + 6)^\circ = (12x)^\circ\)  
\[
6 = 2x
3 = x
\]

3.2 Algebra Skills (p. 120)

44. \(13.6 + 9.8 = 23.4\)  
45. \(14 - 2.21 = 11.79\)

46. \(7.4 \times 5.9 = 43.66\)  
47. \(79.2 \div 9 = 8.8\)

48. \(100 - 4.5 - 26.1 = 69.4\)

49. \(30 \times 11.1 = 333\)

Quiz 1 (p. 120)

1. Sample answer: \(\overrightarrow{CG}\) and \(\overrightarrow{BF}\)

2. Sample answer: \(\overrightarrow{AD}\)

3. Sample answer: \(\overrightarrow{BC}\)

4. Sample answer: \(\overrightarrow{BC}\)

5. \(z^\circ + 23^\circ = 90^\circ\)  
\[
z = 67
\]

6. \((3x)^\circ + 57^\circ = 90^\circ\)  
7. \((3y - 12)^\circ = 90^\circ\)

\[
3x = 33
3y = 102
x = 11
y = 34
\]

Lesson 3.3

3.3 Checkpoint (p. 122)

1. alternate exterior angles  2. same-side interior angles

3. corresponding angles  4. alternate interior angles

5. corresponding angles  6. same-side interior angles

3.3 Guided Practice (p. 123)
Chapter 3 continued

5. one of: \( \angle 1 \) and \( \angle 5 \), \( \angle 2 \) and \( \angle 6 \), \( \angle 3 \) and \( \angle 7 \), \( \angle 4 \) and \( \angle 8 \)
6. \( \angle 3 \) and \( \angle 5 \), or \( \angle 4 \) and \( \angle 6 \)
7. \( \angle 1 \) and \( \angle 7 \), or \( \angle 2 \) and \( \angle 8 \)
8. \( \angle 4 \) and \( \angle 5 \), or \( \angle 3 \) and \( \angle 6 \)

3.3 Practice and Applications (pp. 123–125)
9. \( \angle 1 \) and \( \angle 2 \) are same-side interior angles.
10. \( \angle 1 \) and \( \angle 2 \) are alternate interior angles.
11. \( \angle 1 \) and \( \angle 2 \) are corresponding angles.
12. one of: \( \angle 1 \) and \( \angle 4 \), \( \angle 2 \) and \( \angle 6 \), \( \angle 4 \) and \( \angle 8 \), \( \angle 6 \) and \( \angle 10 \), \( \angle 3 \) and \( \angle 7 \), \( \angle 5 \) and \( \angle 9 \).
13. one of: \( \angle 2 \) and \( \angle 3 \), \( \angle 5 \) and \( \angle 8 \), \( \angle 6 \) and \( \angle 7 \)
14. one of: \( \angle 1 \) and \( \angle 5 \), \( \angle 3 \) and \( \angle 10 \), \( \angle 4 \) and \( \angle 9 \), \( \angle 1 \) and \( \angle 9 \)
15. one of: \( \angle 2 \) and \( \angle 4 \), \( \angle 5 \) and \( \angle 7 \), \( \angle 6 \) and \( \angle 8 \)
16. \( \angle 6 \) and \( \angle 7 \) are alternate interior angles.
17. \( \angle 1 \) and \( \angle 6 \) are alternate exterior angles.
18. \( \angle 2 \) and \( \angle 4 \) are corresponding angles.
19. \( \angle 2 \) and \( \angle 6 \) are corresponding angles.
20. \( \angle 4 \) and \( \angle 8 \) are same-side interior angles.
21. \( \angle 4 \) and \( \angle 7 \) are alternate interior angles.
22. \( \angle 7 \) and \( \angle 8 \) are same-side interior angles.
23. \( \angle BCA \) and \( \angle DGI \) are alternate exterior angles.
24. \( \angle DGI \) and \( \angle FDE \) are corresponding angles.
25. \( \angle FDE \) and \( \angle KHL \) are alternate exterior angles.
26. \( \angle DGI \) and \( \angle GJH \) are alternate interior angles.
27. \( \angle CGH \) and \( \angle GJH \) are corresponding angles.
28. \( \angle BCA \) and \( \angle CGH \) are corresponding angles.
29. \( \angle 5 \) and \( \angle 12 \), \( \angle 7 \) and \( \angle 10 \)
30. \( \angle 8 \) and \( \angle 11 \), \( \angle 6 \) and \( \angle 9 \)
31. \( \angle 8 \) and \( \angle 9 \), \( \angle 6 \) and \( \angle 11 \)
32. three of: \( \angle 5 \) and \( \angle 9 \), \( \angle 6 \) and \( \angle 10 \), \( \angle 7 \) and \( \angle 11 \), \( \angle 8 \) and \( \angle 12 \)

33.

3.3 Standardized Test Practice (p. 125)
34. B  35. J

3.3 Mixed Review (p. 125)
36. \( \overline{AB} \) or \( \overline{AE} \)
37. \( \overline{AB}, \overline{EF} \) or \( \overline{GH} \)
38. \( \overline{AB}, \overline{CD}, \overline{BF}, \) or \( \overline{CG} \)
39. plane \( ABC \)
40. \( x^2 + 54^\circ = 90^\circ \)
   \( x = 36 \)
41. \( 3x^o + 18^o = 90^o \)
   \( 3x = 72 \)
   \( x = 24 \)

3.3 Algebra Skills (p. 125)
43. \( \frac{32 \, \text{ft}}{80 \, \text{ft}} = \frac{2}{5} \)
44. \( \frac{6 \, \text{yd}}{24 \, \text{ft}} \cdot \frac{3 \, \text{ft}}{1 \, \text{yd}} = \frac{18}{24} = \frac{3}{4} \)
45. \( \frac{7 \, \text{ft}}{84 \, \text{in.}} \cdot \frac{12 \, \text{in.}}{1 \, \text{ft}} = \frac{84}{84} = 1 \)
46. \( \frac{10 \, \text{mi}}{800 \, \text{ft}} \cdot \frac{5280 \, \text{ft}}{1 \, \text{mi}} = \frac{52,800}{800} = 66 \)
47. \( y(y + 9) = 4(4 + 9) \)
   \( = 4(13) \)
   \( = 52 \)
   \( = 8 \)
49. \( (y - 1)(y + 1) = (4 - 1)(4 + 1) \)
   \( = (3)(5) \)
   \( = 15 \)

Lesson 3.4
3.4 Activity (pp. 126–127)
1. Sample answer: \( \angle 1 \) and \( \angle 5 \); measures will vary, but will be equal.
2. Sample answer: \( \angle 3 \) and \( \angle 6 \), or \( \angle 4 \) and \( \angle 5 \); measures will vary, but will be equal.
3. Sample answer: \( \angle 2 \) and \( \angle 7 \), or \( \angle 1 \) and \( \angle 8 \); measures will vary, but will be equal.
4. Sample answer: \( \angle 3 \) and \( \angle 5 \), or \( \angle 4 \) and \( \angle 6 \); measures will vary, but will have the sum \( 180^\circ \).

Step 7. Conjecture: When two parallel lines are cut by a transversal, the pairs of corresponding angles have equal measures.
5. Tables will vary. Conjecture: When two parallel lines are cut by a transversal, the pairs of alternate interior angles have equal measures.
6. Tables will vary. Conjecture: When two parallel lines are cut by a transversal, the pairs of alternate exterior angles have equal measures.
7. Tables will vary. Conjecture: When two parallel lines are cut by a transversal, the pairs of same-side interior angles have measures that add up to \( 180^\circ \).
Chapter 3 continued

8. Yes. When two parallel lines are cut by a transversal, the corresponding angles have equal measures, so $m\angle 2 = 90^\circ = m\angle 6$. Therefore, $\angle 6$ is a right angle. Since lines $s$ and $k$ intersect to form a right angle, $s \perp k$.

3.4 Checkpoint (pp. 128–131)
1. $m\angle 1 = 120^\circ$  2. $m\angle 2 = 145^\circ$  3. $m\angle 3 = 45^\circ$
4. $m\angle 4 = 90^\circ$  5. $m\angle 5 = 65^\circ$  6. $m\angle 6 = 100^\circ$
7. $m\angle 7 = 130^\circ$  8. $m\angle 8 = 42^\circ$  9. $m\angle 9 = 90^\circ$
10. $\angle 1$ and $\angle 8$ are congruent by the Alternate Exterior Angles Theorem.
11. $\angle 3$ and $\angle 4$ are not congruent; the angles are a linear pair.
12. $\angle 4$ and $\angle 2$ are not congruent; the angles are a linear pair.
13. $\angle 2$ and $\angle 7$ are congruent by the Alternate Exterior Angles Theorem.
14. $\angle 3$ and $\angle 7$ are congruent by the Corresponding Angles Postulate.
15. $\angle 3$ and $\angle 8$ are not congruent; there is no special relationship between these angles.

3.4 Guided Practice (p. 132)
1. corresponding angles  2. alternate interior angles
3. none of these  4. corresponding angles
5. alternate exterior angles  6. corresponding angles
7. same-side interior angles  8. none of these
9. Alternate Exterior Angles Theorem
10. Alternate Interior Angles Theorem
11. Same-Side Interior Angles Theorem
12. Corresponding Angles Postulate
13. The measure of all the other angles is $90^\circ$. Example explanation: The two lines that form the $90^\circ$ angle are perpendicular, so the other three angles formed by the two lines are also $90^\circ$ angles. Since each of the other four angles is a corresponding angle to one of the right angles, the other four angles are right angles by the Corresponding Angles Postulate.

3.4 Practice and Applications (pp. 132–135)
14. 
15. 
16. $m\angle 1 = 110^\circ$  17. $m\angle 2 = 90^\circ$  18. $m\angle 3 = 50^\circ$
19. $m\angle 1 = 37^\circ$  20. $m\angle 2 = 127^\circ$  21. $m\angle 3 = 94^\circ$
22. $m\angle ABC = 131^\circ$  23. $m\angle ABC = 94^\circ$
24. $m\angle ABC = 60^\circ$
25. $m\angle 1 = 42^\circ$ by the Alternate Interior Angles Theorem.
26. $m\angle 1 = 135^\circ$ by the Corresponding Angles Postulate; $m\angle 2 = 135^\circ$ by the Vertical Angles Theorem.
27. $m\angle 1 = 82^\circ$ by the Alternate Interior Angles Theorem; $m\angle 2 = 82^\circ$ by the Vertical Angles Theorem.
28. $m\angle 1 = 118^\circ$ by the Alternate Interior Angles Theorem; $m\angle 2 = 180^\circ - 118^\circ = 62^\circ$ by the Same-Side Interior Angles Theorem.
29. $m\angle 1 = 180^\circ - 49^\circ = 131^\circ$
30. $m\angle 2 = 180^\circ - 77^\circ = 103^\circ$
31. $m\angle 3 = 180^\circ - 104^\circ = 76^\circ$
32. $2y^\circ = 70^\circ$  33. $5y^\circ = 115^\circ$
$y = 35$  $y = 23$
34. $6y^\circ + 120^\circ = 180^\circ$
$6y = 60$  $5x = 115$
$y = 10$  $x = 23$
36. $(13x - 5)^\circ = 86^\circ$
$13x = 91$
$x = 7$
37. $7(x - 7)^\circ = 126^\circ$
$7x - 49 = 126$
$7x = 175$
$x = 25$
38. $\angle ABP \equiv \angle DEB$ and $\angle PBC \equiv \angle BEF$ by the Corresponding Angles Postulate.
By the Angle Addition Postulate,
$m\angle ABC = m\angle ABP + m\angle PBC$ and
$m\angle DEF = m\angle DEB + m\angle BEF$
So, by the Addition Property of Equality $m\angle ABC = m\angle DEF$.
Therefore $\angle ABC \equiv \angle DEF$.
39. 
40. 
3.4 Standardized Test Practice (p. 134)
41. C  42. J
3.4 Mixed Review (p. 135)
43. Line $j$ and line $k$ are parallel.
44. Line $j$ and line $m$ are perpendicular.
45. Line $k$ and line $m$ are skew.
46. Line $m$ is perpendicular to plane $B$.
47. $\angle 3$ and $\angle 4$ and $\angle 8$, $\angle 1$ and $\angle 5$, $\angle 2$ and $\angle 6$
Lesson 3.5

3.5 Checkpoint (pp. 136–139)

1. If two angles are congruent, then the two angles have the same measure; true
2. If \( m \angle 3 + m \angle 4 = 90^\circ \), then \( \angle 3 \) and \( \angle 4 \) are complementary; true
3. If \( \angle 1 \equiv \angle 2 \), then \( \angle 1 \) and \( \angle 2 \) are right angles; false
4. Yes. The two marked angles are corresponding and congruent. There is enough information to use the Corresponding Angles Converse to conclude that \( RT \parallel XZ \).
5. No. You are not given any information about the angles formed by \( SY \) and \( XZ \).
6. Yes. Sample answer: You can conclude that \( \angle SYX = 90^\circ \) because \( XZ \perp SY \). So, there is enough information to use the Corresponding Angles Converse to conclude that \( RT \parallel XZ \).
7. Yes. The angle congruence marks on the diagram allow you to conclude that \( c \parallel d \) by the Alternate Exterior Angles Converse.
8. \( 2x^2 + 70^\circ = 180^\circ \)  
   \( 2x = 110 \)  
   \( x = 55 \)  
9. \( 4x^2 + 2x^2 = 180^\circ \)  
   \( 6x = 180 \)  
   \( x = 30 \)
10. \( (x + 22)^\circ + 90^\circ = 180^\circ \)  
    \( x + 112 = 180 \)  
    \( x = 68 \)

3.5 Guided Practice (p. 139)

1. The converse of an if-then statement is the statement formed by switching the hypothesis and the conclusion.
2. Sample answer: If it is not raining, then we will go camping.
   Converse: If we go camping, then it is not raining.

3.5 Practice and Applications (pp. 140–142)

6. If two lines are parallel, then the lines never intersect in a plane; true
7. If \( m \angle 1 + m \angle 2 = 180^\circ \), then \( \angle 1 \) and \( \angle 2 \) are supplementary; true
8. If \( \angle A \) is acute, then \( \angle A \) measures \( 38^\circ \); false
9. If \( \angle B \) is obtuse, then \( \angle B \) measures \( 123^\circ \); false
10. The angle congruence marks allow you to conclude that \( m \parallel n \) by the Corresponding Angles Converse.
11. The angle congruence marks allow you to conclude that \( m \parallel n \) by the Corresponding Angles Converse.
12. No; there is no information about the angles formed by the transversal and line \( n \).
13. The angle congruence marks allow you to conclude that \( m \parallel n \) by the Alternate Interior Angles Converse.
Chapter 3 continued

14. The angle congruence marks allow you to conclude that $\overline{AB} \parallel \overline{CD}$ by the Alternate Interior Angles Converse.

15. There is not enough information given to conclude that $m \parallel n$. The angles have no special relationship.

16. Yes; Sample answer: $m\angle ABE = 180^\circ - 57^\circ = 123^\circ$ (Linear Pair Postulate), so $\overline{AC} \parallel \overline{DF}$ by the Corresponding Angles Converse.

17. Yes; Sample answer: $m\angle ABE = 143^\circ$ by the Vertical Angles Theorem; $143^\circ + 37^\circ = 180^\circ$, so $\overline{AC} \parallel \overline{DF}$ by the Same-Side Interior Angles Converse.

18. No; there is not enough information to conclude anything about the angles formed by $\overline{BE}$ and $\overline{DF}$.

19. Yes; Sample answer: $m\angle ABE = 180^\circ - 115^\circ = 65^\circ$ by the Linear Pair Postulate. So, $\overline{AC} \parallel \overline{DF}$ by the Alternate Interior Angles Converse.

20. Yes; because $\angle 1 \cong \angle 2$ and $\angle 1$ and $\angle 2$ are alternate interior angles, $\overline{AB} \parallel \overline{DC}$ by the Alternate Interior Angles Converse.

21. $3x + 2 = 62^\circ$

22. $3x = 60$

23. $x = 20$

24. $3x^2 = 105^\circ$

25. $x = 35$

26. $3x = 84$

27. $2x = 118$

28. $x = 35$

29. $x = 21$

30. Sample answer: If two parallel lines are cut by a transversal, then the bisectors of the alternate interior angles are parallel. By Alternate Interior Angles Theorem, $\angle BFG \cong \angle FGC$. $m\angle BFG = m\angle FGC$.

31. $\overline{AB} \parallel \overline{CD}$ by the Alternate Exterior Angles Converse.

32. $\overline{BC} \parallel \overline{DF}$ by the Same-Side Interior Angles Converse ($75^\circ + 105^\circ = 180^\circ$).

33. By the Corresponding Angles Converse, $m\angle 2 = 32^\circ$. By the Alternate Interior Angles Converse, $m\angle 1$ must equal $m\angle 2$, or $32^\circ$, for the step to be parallel to the floor.

34. $m\angle 1 = m\angle 4 = 40^\circ$ by the Alternate Interior Angles Converse.

3.5 Standardized Test Practice (p. 142)

35. B

36. $3x^2 + (x + 20)^2 = 180^\circ$

46. $\frac{7}{12} + \frac{5}{12} = \frac{12}{12} = 1$

3.5 Mixed Review (p. 142)

37. $m\angle 1 = m\angle 2 = 90^\circ$

38. $\angle 1$ and $\angle 2$ are complementary.

39. $m\angle 1 = m\angle 2 = 90^\circ$; $u \perp v$

40. alternate exterior angles

41. corresponding angles

42. By the Corresponding Angles Theorem, $m\angle 4 = 72^\circ$.

43. By the Same-Side Interior Angles Theorem, $m\angle 2 + m\angle 4 = 180^\circ$

$m\angle 2 = 108^\circ$.

3.5 Algebra Skills (p. 142)

44. $\frac{3}{8} + \frac{7}{8} = \frac{10}{8} = \frac{5}{4}$, or $1\frac{1}{4}$

45. $\frac{7}{12} + \frac{5}{12} = \frac{12}{12} = 1$

47. $\frac{8}{9} - \frac{2}{9} = \frac{6}{9} = \frac{2}{3}$

Lesson 3.6

3.6 Checkpoint (pp. 144–146)

1. $m\angle 1 = m\angle 2$ by the Angle Addition Postulate.

2. You can apply Theorem 3.11. If $a \parallel b$ and $b \parallel c$, then $a \parallel c$.

3. $(5x + 10)^\circ = 90^\circ$

$5x = 80$

$x = 16$
Chapter 3 continued

3.6 Guided Practice (p. 147)

1. a straightedge and a compass
2. Theorem 3.11: If two lines are parallel to the same line, then they are parallel to each other.
3. Theorem 3.12: In a plane, if two lines are perpendicular to the same line, then the lines are parallel to each other.

3.6 Practice and Applications (pp. 147–149)

4. Theorem 3.11: If two lines are parallel to the same line, then the two lines are parallel to each other.
5. Theorem 3.12: In a plane, if two lines are perpendicular to the same line, then the lines are parallel to each other.
6. By the Alternate Interior Angles Converse, \( j \parallel k \).
7. By the Corresponding Angles Converse, \( c \parallel d \).
8. By the Alternate Exterior Angles Converse, \( c \parallel d \).
9. By the Alternate Interior Angles Converse, \( c \parallel d \).
10. Because \( 85^\circ + 95^\circ = 180^\circ \), \( c \parallel d \) by the Same-Side Interior Angles Converse.
11. Because \( n \perp c \) and \( n \perp d \), \( c \parallel d \) by Theorem 3.12.
12. Because \( 116^\circ + 64^\circ = 180^\circ \), \( c \parallel d \) by the Same-Side Interior Angles Converse.
13. By the Same-Side Interior Angles Converse, \( q \parallel r \) because \( 80^\circ + 100^\circ = 180^\circ \). By the Corresponding Angles Converse, \( q \parallel p \). By Theorem 3.11, because \( q \parallel r \) and \( q \parallel p \), \( p \parallel r \).
14. By the Corresponding Angles Converse, \( h \parallel j \).
15. Since \( a \perp d \) and \( b \perp d \), \( a \parallel b \) by Theorem 3.12. Since \( c \perp a \) and \( d \perp a \), \( c \parallel d \) also by Theorem 3.12.
16. None of the lines are parallel because you do not know if \( b \perp w \) or if \( a \perp x \).
17. Because the 8th fret is parallel to the 9th fret and the 9th fret is parallel to the 10th fret, the 8th fret is parallel to the 10th fret by Theorem 3.11.
18. Sample answer: Show that two alternate interior angles are congruent and use the Alternate Interior Angles Converse.
19. \((7x + 13)^\circ = 90^\circ\)
   \[ 7x = 77 \]
   \[ x = 11 \]
20. \(9x^\circ + (8x + 10)^\circ = 180^\circ\)
   \[ 17x + 10 = 180 \]
   \[ 17x = 170 \]
   \[ x = 10 \]
21. \(15x^\circ = 90^\circ\)
   \[ x = 6 \]

3.6 Standardized Test Practice (p. 149)

27. A: \((4x + 10)^\circ = 90^\circ\)
   \[ 4x = 80 \]
   \[ x = 20 \]
28. a. Because \( \angle ABD \equiv \angle CDF \), \( \overline{AB} \parallel \overline{CD} \) by the Corresponding Angles Converse.
   b. Because \( 100^\circ + 80^\circ = 180^\circ \), \( \overline{CD} \parallel \overline{EF} \) by the Same-Side Interior Angles Converse.
   c. \( m\angle 1 = 90^\circ \); because \( \overline{AB} \parallel \overline{CD} \) and \( \overline{CD} \parallel \overline{EF} \), then \( \overline{AB} \parallel \overline{EF} \) by Theorem 3.11. \( \angle 1 \) and \( \angle AEF \) are same-side interior angles, so
   \[ m\angle 1 = 180^\circ - m\angle AEF = 180^\circ - 90^\circ = 90^\circ. \]

3.6 Mixed Review (p. 149)

29. true  30. false  31. true  32. false
33–36.

3.6 Algebra Skills (p. 149)

37. \(-5 \cdot 6 - 10 \div 5 = -30 - 2 = -32 \)
38. \(-8 + 33 - 14 = 25 - 14 = 11 \)
39. \(24 \div (9 + 3) = 24 \div 12 = 2 \)
Chapter 3 continued

40. \(4(8 - 3)^2 - 12 = 4(5)^2 - 12\)
    \[= 4(25) - 12\]
    \[= 100 - 12\]
    \[= 88\]

41. \(48 - 3^2 \cdot 5 - 6^2 = 48 - 9(5) - 36\)
    \[= 48 - 45 - 36\]
    \[= 3 - 36\]
    \[= -33\]

42. \([(1 - 8)^2 + 7] \div 8 = [(-7)^2 + 7] \div 8\)
    \[= (49 + 7) \div 8\]
    \[= 56 \div 8\]
    \[= 7\]

3.6 Technology Activity (pp. 150–151)
1. yes; Corresponding Angle Converse
2. Slopes may vary, but will be equal.
3. The measures of corresponding angles will vary, but will be equal.
4. If two lines are parallel, then their slopes are equal.
5. In a plane, if two lines are perpendicular to the same line, then they are parallel to each other (Theorem 3.12).
6. If the slopes are equal, then the lines are parallel.
7. \(-1\)
8. The slopes change, but the product is still \(-1\).
9. Theorem 3.11: If two lines are parallel to the same line, then they are parallel to each other; the slopes of lines \(l\) and \(m\) are equal.

Lesson 3.7

3.7 Checkpoint (pp. 152–154)
1. No, this is not a translation. The image is a mirror image of the original figure.
2. Yes, this is a translation.
3. No, this is not a translation. The original figure is rotated.
4. Each point is moved 3 units to the left and 4 units down \((x, y) \rightarrow (x - 3, y - 4)\).
5. Each point is moved 5 units to the left and 2 units up; \((x, y) \rightarrow (x - 5, y + 2)\).

3.7 Guided Practice (p. 155)
1. A translation is a slide that moves each point on a figure the same distance in the same direction.
2. image 3. translation
4. not a translation 5. translation
6. True. Each point is moved 2 units down and 3 units to the left.
7. False. To move from \(\triangle ABC\) to \(\triangle A'B'C'\), shift 3 units to the left and 2 units down.
8. true

3.7 Practice and Applications (pp. 155–159)
9. The red figure is not a translation of the blue figure.
10. The red figure is a translation of the blue figure.
11. The red figure is not a translation of the blue figure.
12. The red figure is a translation of the blue figure.
13. The red figure is not a translation of the blue figure.
14. The red figure is not a translation of the blue figure.
19. Each point is moved 2 units to the right and 3 units up.
20. Each point is moved 1 unit to the right and 4 units down.
21. Each point is moved 2 units to the left and 3 units up.
22. \((x, y) \rightarrow (x + 2, y - 4)\) 23. \((x, y) \rightarrow (x - 4, y + 1)\)
24. \((2, 5) \rightarrow (2 + 4, 5 - 3) \rightarrow (6, 2)\)
25. \((-3, 7) \rightarrow (-3 + 4, 7 - 3) \rightarrow (1, 4)\)
26. \((-1, -4) \rightarrow (-1 + 4, -4 - 3) \rightarrow (3, -7)\)
27. \((4, -6) \rightarrow (4 + 4, -6 - 3) \rightarrow (8, -9)\)
28. \((0, 0) \rightarrow (0 + 4, 0 - 3) \rightarrow (4, -3)\)
29. \((-4, 3) \rightarrow (-4 + 4, 3 - 3) \rightarrow (0, 0)\)
30. \((3, -4) \rightarrow (3 + 4, -4 - 3) \rightarrow (7, -7)\)
31. \((-1, -1) \rightarrow (-1 + 4, -1 - 3) \rightarrow (3, -4)\)
32. \( P \rightarrow P' \)
   \((-1, 1) \rightarrow (-1 + 1, 1 - 4) \rightarrow (0, -3)\)
   \(Q \rightarrow Q'\)
   \((2, 4) \rightarrow (2 + 1, 4 - 4) \rightarrow (3, 0)\)
   \(R \rightarrow R'\)
   \((6, 3) \rightarrow (6 + 1, 3 - 4) \rightarrow (7, -1)\)
   \(S \rightarrow S'\)
   \((2, -1) \rightarrow (2 + 1, -1 - 4) \rightarrow (3, -5)\)

33. \( P \rightarrow P' \)
   \((-1, 1) \rightarrow (-1 - 3, 1 + 2) \rightarrow (-4, 3)\)
   \(Q \rightarrow Q'\)
   \((2, 4) \rightarrow (2 - 3, 4 + 2) \rightarrow (-1, 6)\)
   \(R \rightarrow R'\)
   \((6, 3) \rightarrow (6 - 3, 3 + 2) \rightarrow (3, 5)\)
   \(S \rightarrow S'\)
   \((2, -1) \rightarrow (2 - 3, -1 + 2) \rightarrow (-1, 1)\)

34. \( P \rightarrow P' \)
   \((-1, 1) \rightarrow (-1 + 5, 1 - 5) \rightarrow (4, -4)\)
   \(Q \rightarrow Q'\)
   \((2, 4) \rightarrow (2 + 5, 4 - 5) \rightarrow (7, -1)\)
   \(R \rightarrow R'\)
   \((6, 3) \rightarrow (6 + 5, 3 - 5) \rightarrow (11, -2)\)
   \(S \rightarrow S'\)
   \((2, -1) \rightarrow (2 + 5, -1 - 5) \rightarrow (7, -6)\)

35. \( P \rightarrow P' \)
   \((-1, 1) \rightarrow (-1 + 0, 1 - 3) \rightarrow (-1, -2)\)
   \(Q \rightarrow Q'\)
   \((2, 4) \rightarrow (2 + 0, 4 - 3) \rightarrow (2, 1)\)
   \(R \rightarrow R'\)
   \((6, 3) \rightarrow (6 + 0, 3 - 3) \rightarrow (6, 0)\)
   \(S \rightarrow S'\)
   \((2, -1) \rightarrow (2 + 0, -1 - 3) \rightarrow (2, -4)\)

36. The White Knight is moved 2 squares up and 1 square left.
37. The Black Knight is moved 1 square down and 2 squares to the right.

38. \(\) 39. \(\)

40. \(\)

41. \(\)

42. \(x - 3 = 0\)\( y + 2 = 3\)
   \(x = 3\)\( y = 1\)
   Corresponding point: \((3, 1)\)

43. \(x + 5 = -2\)\( y - 1 = 4\)
   \(x = -7\)\( y = 5\)
   Corresponding point: \((-7, 5)\)

44. \(x + 3 = 6\)\( y + 7 = -1\)
   \(x = 3\)\( y = -8\)
   Corresponding point: \((3, -8)\)

45. Yes; the image of \((2, -2)\) after the translation \((x, y) \rightarrow (x - 6, y + 4)\) is \((-4, 2)\). This point is labeled \(C'\).

46. Yes, \(\overline{TT'}\) and \(\overline{KK'}\) are parallel.

47. \(m\angle KJ' + m\angle JK' = 180^\circ\)

48. \(\)

49. A 50. F

3.7 Standardized Test Practice (p. 158)
49. A 50. F

3.7 Mixed Review (p. 158)
51. acute; \(m\angle ABC \approx 50^\circ\) 52. obtuse; \(m\angle FGH \approx 135^\circ\)
53. acute; \(m\angle XYZ \approx 80^\circ\)
Chapter 3 continued

3.7 Algebra Skills (p. 159)

54. $0.15(x) = 12.60$
   \[ x = 84 \]
   You spent 84 minutes on long distance calls.

55. $4 \cdot 3 \cdot 2 \cdot 1 = 24$
   The songs can be played in 24 different orders.

56. $-0.4, -0.1, 0, 0.5, 0.9, 1.0$

57. $-4, -1.5, -1.2, 0, 0.7, 1.1, 3.4$

58. $-6.7, -0.77, -0.7, 6.6, 6.7, 7.6$

59. $-6.8, -6.12, -6.1, 6, 6.09, 6.3$

Quiz 3 (p. 159)

1. The angle congruence marks allow you to conclude that $m \parallel n$ by the Alternate Exterior Angles Converse.
2. No; there is no information about line $m$.
3. The angle congruence marks allow you to conclude that $m \parallel n$ by the Alternate Interior Angles Converse.
4. Because $p \perp n$ and $q \perp n$, then $p \parallel q$ by Theorem 3.12
   (In a plane, if two lines are perpendicular to the same line, the lines are parallel.).
5. Because $p \parallel n$ and $n \parallel q$, then $p \parallel q$ by Theorem 3.11
   (If two lines are parallel to the same line, then the lines are parallel.).
6. Because $45^\circ + 45^\circ = 90^\circ$, $p \perp n$. Because $p \perp n$ and $n \perp q$, then $p \parallel q$ by Theorem 3.12. You could also use the Corresponding Angles Converse.

7. \[ P \]

8. $(x, y) \rightarrow (x + 3, y - 3)$

9. $(x, y) \rightarrow (x - 2, y + 3)$

Chapter 3 Summary and Review (pp. 160–163)

1. Two lines are parallel if they lie in the same plane and do not intersect.
2. A transversal is a line that intersects two or more coplanar lines at different points.
3. Two lines are perpendicular if they intersect to form a right angle.
4. Two angles are alternate exterior angles if they lie outside two lines on opposite sides of a transversal.
5. A construction is a geometric drawing that uses a limited set of tools, usually a compass and a straightedge.
6. Two planes that do not intersect are called parallel planes.
7. $\overrightarrow{FH}$ and $\overrightarrow{GH}$ appear to be parallel.
8. $\overrightarrow{KN}$ and $\overrightarrow{JN}$ are perpendicular.

9. $\overrightarrow{FK}$ and $\overrightarrow{HI}$ are skew.
10. $\overrightarrow{JN}$ and $\overrightarrow{MN}$ are perpendicular.
11. Yes, enough information is given. Lines $g$ and $f$ are perpendicular, so by Theorem 3.2 they intersect to form four right angles. So, $m \angle 11 = 90^\circ$. Or, $m \angle 11 = 90^\circ$ by the Vertical Angles Theorem.
12. Yes, enough information is given. If two sides of adjacent acute angles are perpendicular, then the angles are complementary (Theorem 3.4).
13. Yes, enough information is given. By Theorem 3.3, if two lines intersect to form a adjacent congruent angles, then they are perpendicular.
14. Not enough information is given to conclude that $\angle 9 \equiv \angle 10$. All that is known about $\angle 9$ and $\angle 10$ is that $m \angle 9 + m \angle 10 = 90^\circ$.
15. $\angle 8$ and $\angle 12$ are corresponding angles.
16. $\angle 9$ and $\angle 14$ are alternate exterior angles.
17. $\angle 10$ and $\angle 12$ are same-side interior angles.
18. $\angle 11$ and $\angle 12$ are alternate interior angles.
19. By the Corresponding Angles Postulate, $m \angle 9 = 99^\circ$.
20. By the Alternate Interior Angles Theorem, $m \angle 10 = 63^\circ$.
21. By the Same-Side Interior Angles Theorem,
   \[ m \angle 11 + 109^\circ = 180^\circ \]
   \[ m \angle 11 = 71^\circ. \]
22. By the Corresponding Angles Converse, $x = 122$.
23. By the Alternate Exterior Angles Converse,
   \[ 4x^\circ = 80^\circ \]
   \[ x = 20. \]
24. By the Same-Side Interior Angles Converse,
   \[ (x - 15)^\circ + 55^\circ = 180^\circ \]
   \[ x - 15 = 125 \]
   \[ x = 140. \]
25. If two lines are parallel to the same line, then the lines are parallel (Theorem 3.11).
26. In a plane, if two lines are perpendicular to the same line, then the lines are parallel (Theorem 3.12).
27. If two lines are cut by a transversal so that corresponding angles are congruent, then the lines are parallel (Corresponding Angles Converse).
28. The red figure is not a translation of the blue figure, it is a mirror image.
29. The red figure is a translation of the blue figure.
30. The red figure is not a translation of the blue figure, it is a rotation.
31. Each point is moved 5 units to the right and 3 units down.
32. $(x, y) \rightarrow (x + 5, y - 3)$
Chapter 3 Test (p. 164)
1. $PT$ and $UV$ are skew.
2. $TW$ and $WV$ are perpendicular.
3. $PT$ and $SW$ appear parallel.
5. $TW$ is perpendicular to plane $SWV$.
6. $m\angle FGJ + m\angle JGH = 90^\circ$
7. $(2x + 14)^\circ = 90^\circ$
   \[ 2x = 76 \]
   \[ x = 38 \]
8. alternate interior angles
9. corresponding angles
10. corresponding angles
11. alternate exterior angles
12. same-side interior angles
13. corresponding angles
14. By the Corresponding Angles Postulate, $m\angle 1 = 108^\circ$.
   Also, $m\angle 3 + 108^\circ = 180^\circ$ by the Linear Pair Postulate, so $m\angle 3 = 72^\circ$. By the Alternate Interior Angles Theorem, $\angle 2 \cong \angle 3$, so $m\angle 2 = 72^\circ$.
15. $(3y + 1)^\circ = 67^\circ$
16. $(2y)^\circ + 116^\circ = 180^\circ$
   \[ 3y = 66 \]
   \[ 2y = 64 \]
   \[ y = 22 \]
   \[ y = 32 \]
17. Yes; because $\overline{AB} \perp \overline{EF}$ and $\overline{CD} \perp \overline{EF}$, $\overline{AB} \parallel \overline{CD}$ by Theorem 3.12 (In a plane, if two lines are perpendicular to the same line, then the lines are parallel).
18. Each point is moved 6 units to the right and 2 units up; $(x, y) \rightarrow (x + 6, y + 2)$

Chapter 3 Standardized Test (p. 165)
1. B  2. G
3. A; $(x + 12)^\circ + 62^\circ = 90^\circ$
   \[ x + 12 = 28 \]
   \[ x = 16 \]
4. G  5. A
6. F; $2y^\circ + 110^\circ = 180^\circ$
   \[ 2y = 70 \]
   \[ y = 35 \]
7. a. Because the two angles marked $108^\circ$ are congruent corresponding angles, $e \parallel f$ by the Corresponding Angles Converse.
b. Because $72^\circ + 108^\circ = 180^\circ$, $f \parallel g$ by the Same-Side Interior Angles Converse.
c. Because $e \parallel f$ and $f \parallel g$, $e \parallel g$ by Theorem 3.11 (In a plane, if two lines are parallel to the same line, the lines are parallel.).
d. Because $e \parallel g$, $m\angle 4 + 90^\circ = 180^\circ$ by the Same-Side Interior Angles Theorem. Therefore, $m\angle 4 = 90^\circ$.
8. D

Chapter 3 Algebra Review (p. 167)
1. $x - 3 > 12$
   \[ x > 15 \]
2. $8q + 1 < 25$
3. $-3z + 8 \geq 20$
   \[ 8q < 24 \]
   \[ -3z \geq 12 \]
   \[ q < 3 \]
   \[ z \leq -4 \]
4. $16 - 9c \leq -2$
   \[ -9c \leq -18 \]
   \[ c \geq 2 \]
5. $10 - 2p \leq -4p + 4$
6. $5k - 6 > 3k + 16$
   \[ -2p \leq -4p - 6 \]
   \[ 2k - 6 > 16 \]
   \[ 2p \leq -6 \]
   \[ 2k > 22 \]
   \[ p \leq -3 \]
   \[ k > 11 \]
7. $4^2 = 4 \cdot 4 = 16$
8. $14^2 = 14 \cdot 14 = 196$
9. $(-3)^2 = (-3)(-3) = 9$
10. $(-11)^2 = (-11)(-11) = 121$
11. $(\sqrt{5})^2 = (\sqrt{5})(\sqrt{5}) = 5$
12. $\sqrt{100}^2 = \sqrt{10}(\sqrt{10}) = 10$
13. $\sqrt{81} = \sqrt{9^2} = 9$
14. $\sqrt{400} = \sqrt{20^2} = 20$

Chapters 1–3 Cumulative Practice (pp. 168–169)
1. Each number in the pattern after the first is found by adding consecutive integers. The next number in the pattern is $24 + 6 = 30$.
2. Sample answer: $(1)^2 = 1$ (or any number between 0 and 1)
6. $\overrightarrow{DT}$ and $\overrightarrow{AC}$, or $\overrightarrow{BC}$ and $\overrightarrow{DT}$
7. $DE + EF = DF$
8. $LM + MN = LN$
   $DE + 9 = 25$
   \[ 5 + MN = 16 \]
   \[ DE = 16 \]
   \[ MN = 11 \]
9. $PQ + QR = PR$
   $PQ + 12 = 19$
   $PQ = 7$

$\angle ABC$ is an obtuse angle.
11. \( \angle ABC \) is a right angle.

12. \( AC = CB = 29; \quad 13. (2x + 7)\degree = 41\degree \\
    \quad AB = AC + CB \quad 2x = 34 \\
\quad = 29 + 29 \quad x = 17 \\
\quad = 58 \\
14. \( 2x^2 + 3x^2 = 90\degree \)  \\
\quad 5x = 90 \\
\quad x = 18 \\
15. \( 2n^2 + (n + 15)^2 = 180^\circ \)  \\
\quad 3n + 15 = 180 \\
\quad 3n = 165 \\
\quad n = 55 \\
16. \( 3x^2 = 30^\circ \)  \\
\quad x = 10 \\
17. If two lines intersect, then they are coplanar.
18. Symmetric Property of Congruence 
19. Transitive Property of Equality 
20. Subtraction Property of Equality 

21. 

22. 

23. \( \angle 4 \) and \( \angle 2, \angle 4 \) and \( \angle 9, \angle 5 \) and \( \angle 10, \) and \( \angle 1 \) and \( \angle 7 \\
24. m\angle 6 = 55^\circ \) by the Alternate Interior Angles Theorem. 
25. \( m\angle 4 = 55^\circ \) by the Corresponding Angles Postulate. 
26. Because \( \angle 3 \) and \( \angle 6 \) form a pair of same-side interior angles and \( m\angle 3 + m\angle 6 = 180^\circ, \ \overrightarrow{AC} \parallel \overrightarrow{DE} \) by the Same-Side Interior Angles Converse. 
27. Yes, there is enough information. By the Alternate Interior Angles Converse, \( m \parallel n. \) 
28. No, not enough information is given to conclude \( m \parallel n \) because you know nothing about the angles formed by the intersection of the transversal and \( n \).

29. Sample answer: Yes, lines \( m \) and \( n \) are parallel by the Same-Side Interior Angles Converse, because \( 60^\circ + (60^\circ + 60^\circ) = 180^\circ. \) 
30. \( \angle 1 \) and \( \angle 2 \) are same-side interior angles, so \( m\angle 1 + m\angle 2 = 180^\circ \)  \\
\quad 35^\circ + m\angle 2 = 180^\circ \\
\quad m\angle 2 = 145^\circ. \\
31. Because \( \angle 1 \) and \( \angle 3 \) are corresponding angles, \( m\angle 1 = 40^\circ \) by the Corresponding Angles Theorem. 
32. Because each post is perpendicular to the deck, the posts are parallel to each other by Theorem 3.12 (In a plane, if two lines are perpendicular to the same line, the lines are parallel.). 
33. 

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