CHAPTER 3 • Parallel Lines and Planes

Page 75 • CLASSROOM EXERCISES

1. **a.** $\angle 1, \angle 5; \angle 2, \angle 6; \angle 3, \angle 7; \angle 4, \angle 8$ **b.** $\angle 2, \angle 8; \angle 3, \angle 5$ **c.** $\angle 2, \angle 5; \angle 3, \angle 8$
d. $\angle 1, \angle 7; \angle 4, \angle 6$ **e.** $\angle 1, \angle 6; \angle 4, \angle 7$

2. s-s. int. $\angle$s **3.** corr. $\angle$s **4.** none **5.** alt. int. $\angle$s **6.** none

7. corr. $\angle$s **8.** s-s. int. $\angle$s **9.** alt. int. $\angle$s

10. **a.** $\parallel$ **b.** $\parallel$ **c.** skew **d.** int. **e.** skew **f.** skew

11. $\overleftrightarrow{AB}, \overleftrightarrow{EJ}, \overleftrightarrow{FK}, \overleftrightarrow{HM}, \overleftrightarrow{IN}, \overleftrightarrow{DC}$

12. $\overleftrightarrow{HI}, \overleftrightarrow{ID}, \overleftrightarrow{FE}, \overleftrightarrow{EA}, \overleftrightarrow{JK}, \overleftrightarrow{JB}, \overleftrightarrow{MN}, \overleftrightarrow{NC}, \overleftrightarrow{BC}, \overleftrightarrow{AD}$

13. $\overleftrightarrow{EJ}, \overleftrightarrow{FK}, \overleftrightarrow{GL}, \overleftrightarrow{HM}, \overleftrightarrow{IN}$ **14.** Answers may vary; for example, $\overline{EF}, \overline{HI}; \overline{BJ}, \overline{LM}$

15. never **16.** always **17.** sometimes **18.** never

19. **a.** sometimes **b.** sometimes **c.** sometimes

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A **1.** alt. int. $\angle$s **2.** corr. $\angle$s **3.** s-s. int. $\angle$s **4.** alt. int. $\angle$s **5.** corr. $\angle$s

6. corr. $\angle$s **7.** $\overleftrightarrow{PQ}, \overleftrightarrow{SR}; \overleftrightarrow{SQ}$ **8.** $\overleftrightarrow{SP}, \overleftrightarrow{QR}; \overleftrightarrow{SQ}$ **9.** $\overleftrightarrow{PQ}, \overleftrightarrow{SR}; \overleftrightarrow{PS}$

10. $\overleftrightarrow{PS}, \overleftrightarrow{QR}; \overleftrightarrow{SR}$ **11.** $\overleftrightarrow{PQ}, \overleftrightarrow{SR}; \overleftrightarrow{QR}$ **12.** corr. $\angle$s **13.** corr. $\angle$s

14. alt. int. $\angle$s **15.** s-s. int. $\angle$s **16.** s-s. int. $\angle$s **17.** corr. $\angle$s **18.** Corr. $\angle$s are $\cong$.

19. Alt. int. $\angle$s are $\cong$. **20.** S-s. int. $\angle$s are supp.

B **21.** **a.** Answers may vary. **b.** Same as $m\angle 1 + m\angle 2$ **c.** Same as $m\angle 1 + m\angle 2$
d. When 2 nonparallel lines are cut by transversals, the sum of the measures of s-s. int. $\angle$s is a constant.

22. Check students' drawings. **23.** $\overleftrightarrow{BH}, \overleftrightarrow{CI}, \overleftrightarrow{DJ}, \overleftrightarrow{EK}, \overleftrightarrow{FL}$ **24.** $\overleftrightarrow{GH}, \overleftrightarrow{ED}, \overleftrightarrow{KJ}$

25. Answers may vary. $\overleftrightarrow{FL}, \overleftrightarrow{EK}, \overleftrightarrow{DJ}, \overleftrightarrow{CI}, \overleftrightarrow{GL}, \overleftrightarrow{LK}, \overleftrightarrow{JI}, \overleftrightarrow{IH}$ **26.** *CDJI*; *GHIJKL*

27. *ABHG*, *BCIH*, *CDJI*, *DEKJ* **28.** 4

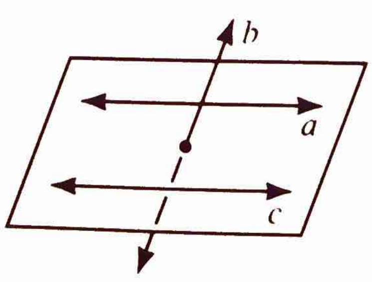
29. If the top and bottom lie in $\parallel$ planes, then $\overline{CD}$ and $\overline{IJ}$ are the lines of intersection of *DCIJ* with 2 $\parallel$ planes, and are therefore $\parallel$.

30. always **31.** sometimes **32.** never **33.** always **34.** sometimes

35. sometimes **36.** sometimes **37.** always **38.** sometimes **39.** sometimes

C **40–42.** Sketches may vary.

40.



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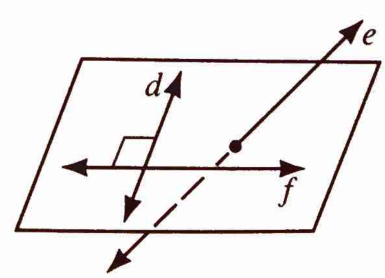

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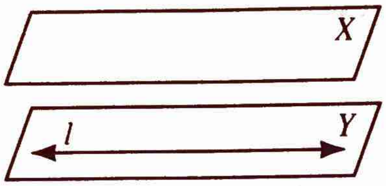

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$\cong$ $\angle$s: corr. $\angle$s, alt. int. $\angle$s, vert. $\angle$s, alt. ext. $\angle$s
supp. $\angle$s: s-s. int. $\angle$s, s-s. ext. $\angle$s, adj. $\angle$s

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1. $l \parallel p$ 2. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
3. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
4. If 2 $\parallel$ lines are cut by a trans., then s-s. int. $\angle$s are supp.
5. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
6. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$. 7. Vert. $\angle$s are $\cong$.
8. If a trans. is $\perp$ to one of two $\parallel$ lines, then it is $\perp$ to the other one also.
9. If 2 $\parallel$ lines are cut by a trans., then s-s. int. $\angle$s are supp.
10. $m\angle 4 = m\angle 5 = m\angle 8 = 130$; $m\angle 2 = m\angle 3 = m\angle 6 = m\angle 7 = 50$
11. $m\angle 4 = m\angle 5 = m\angle 8 = x$; $m\angle 2 = m\angle 3 = m\angle 6 = m\angle 7 = 180 - x$
12. $m\angle 3 + m\angle 4 = 180$; $3m\angle 3 = 180$; $m\angle 3 = 60$, so $m\angle 6 = 60$
13. $m\angle 5 + m\angle 6 = 180$; $2m\angle 6 + 20 = 180$; $m\angle 6 = 80 = m\angle 2$; $m\angle 1 = 100$
14. In Step 2 he used Thm. 3-2, which relies on Post. 10.

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A 1. $\angle 3, \angle 6, \angle 8$ 2. $\angle 6, \angle 9, \angle 14$ 3. $\angle 4, \angle 5, \angle 7, \angle 10, \angle 12, \angle 13, \angle 15$
4. $\angle 1, \angle 3, \angle 6, \angle 8, \angle 9, \angle 11, \angle 14, \angle 16$ 5. 110, 70 6. x, $180 - x$
7. $x = 60$, $y = 61$ 8. $4x + 14x = 180$, $x = 10$; $2y = 90$; $y = 45$
9. $120 + x = 180$, $x = 60$; $60 = 3y + 6$, $y = 18$
10. $x = 70$; $50 + 70 + y = 180$, $y = 60$
11. $3x = 42$, $x = 14$; $3(14) + 6y - 6 = 90$, $y = 9$
12. $x = 55$; $y + 55 + 50 = 180$, $y = 75$
13. 1. Given 2. Def. of $\perp$ lines 3. $l \parallel n$ 4. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$. 5. $m\angle 2 = 90$ 6. Def. of $\perp$ lines

B 14. $x = 56$; $56 + 24 + y = 180$, $y = 100$; $56 + 24 + 4z = 180$, $z = 25$
15. $x = 70$; $5y + 10 = 70$, $y = 12$; $z + 32 = 5(12) + 10$, $z = 38$

16. $3x = 90,\ x = 30;\ 8y + 4 = 68,\ y = 8;\ 2z + 8(8) + 4 = 90,\ z = 11$

17. **a.** $m\angle DAB + 116 = 180,\ m\angle DAB = 64;\ m\angle KAB = 32;\ m\angle DKA = 32$

b. More information is needed.

18. $2x + y = 60,\ 2x - y = 40;\ 4x = 100,\ x = 25;\ y = 10$

19. $4x - 2y = 110,\ 4x + 2y = 130;\ 8x = 240,\ x = 30;\ y = 5$

20.

Statements	Reasons
1. $k \parallel l$	1. Given
2. $\angle 2 \cong \angle 4$	2. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
3. $\angle 4 \cong \angle 7$	3. Vert. $\angle$s are $\cong$.
4. $\angle 2 \cong \angle 7$	4. Trans. Prop.

21.

Statements	Reasons
1. $k \parallel l$	1. Given
2. $\angle 1 \cong \angle 8$, or $m\angle 1 = m\angle 8$	2. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
3. $m\angle 8 + m\angle 7 = 180$	3. $\angle$ Add. Post.
4. $m\angle 1 + m\angle 7 = 180$	4. Substitution Prop.
5. $\angle 1$ is supp. to $\angle 7$.	5. Def. of supp. $\angle$s

22.

Statements	Reasons
1. $k \parallel n$	1. Given
2. $\angle 1 \cong \angle 2$, or $m\angle 1 = m\angle 2$	2. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
3. $m\angle 2 + m\angle 4 = 180$	3. $\angle$ Add. Post.
4. $m\angle 1 + m\angle 4 = 180$	4. Substitution Prop.
5. $\angle 1$ is supp. to $\angle 4$.	5. Def. of supp. $\angle$s

23. **a.**

Statements	Reasons
1. $\overline{AB} \parallel \overline{DC};\ \overline{AD} \parallel \overline{BC}$	1. Given
2. $\angle A$ is supp. to $\angle B$; $\angle C$ is supp. to $\angle B$.	2. If 2 $\parallel$ lines are cut by a trans., then s-s. int. $\angle$s are supp.
3. $\angle A \cong \angle C$	3. If 2 $\angle$s are supps. of the same $\angle$, then the 2 $\angle$s are $\cong$.

b. Yes, by the same reasoning as in part (a).

C **24.**

Statements	Reasons
1. $\overline{AS} \parallel \overline{BT}$	1. Given
2. $m\angle 1 = m\angle 4$	2. If 2 $\parallel$ lines are cut by a trans., then corr. ∠s are ≅.
3. $m\angle 2 = m\angle 5$	3. If 2 $\parallel$ lines are cut by a trans., then alt. int. ∠s are ≅.
4. $m\angle 4 = m\angle 5$	4. Given
5. $m\angle 1 = m\angle 2$	5. Substitution Prop.
6. $\overrightarrow{SA}$ bisects $\angle BSR$.	6. Def. of ∠ bis.

25. Steps 1–5 of the proof in Ex. 24 prove that $m\angle 1 = m\angle 2$. $\overrightarrow{SB}$ bisects $\angle AST$, so $m\angle 2 = m\angle 3$. Since $m\angle 1 + m\angle 2 + m\angle 3 = 180$, $3m\angle 1 = 180$ by Substitution, and $m\angle 1 = 60$.

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1. **a.** True **b.** If 2 lines form ≅ adj. ∠s, then the lines are ⊥. **c.** True

2. **a.** True **b.** If 2 lines are not skew, then they are $\parallel$. **c.** False

3. **a.** True **b.** If 2 ∠s are supp., then the sum of their measures is 180. **c.** True

4. **a.** True **b.** If 2 planes do not intersect, then they are $\parallel$. **c.** True

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1. $\overline{KC} \parallel \overline{DE}$. If 2 lines are cut by a trans. and s-s. int. ∠s are supp., then the lines are $\parallel$.

2. $\overline{OX} \parallel \overline{IZ}$. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are $\parallel$.

3. $\overline{LA} \parallel \overline{TS}$. If 2 lines are cut by a trans. and s-s. int. ∠s are supp., then the lines are $\parallel$.

4. $\overline{GA} \parallel \overline{EM}$. If 2 lines are cut by a trans. and alt. int. ∠s are ≅, then the lines are $\parallel$.

5. $\overline{PL} \parallel \overline{AR}$ **6.** $\overline{PA} \parallel \overline{LR}$ **7.** no segs. $\parallel$ **8.** $\overline{PL} \parallel \overline{AR}$ **9.** no segs. $\parallel$

10. $\overline{PL} \parallel \overline{AR}$ **11.** $\overline{PA} \parallel \overline{LR}$

12. Through a pt. outside a line, there is a line $\parallel$ to the given line. Through a pt. outside a line, there is no more than one line $\parallel$ to the given line.

13. Through a point outside a line, there is a line ⊥ to the given line. Through a point outside a line, there is no more than one line ⊥ to the given line.

14. one **15.** one **16.** one **17.** one; Protractor Post. **18.** Infinitely many

19. **a.** False **b.** True **c.** True **d.** True

20. If $k \parallel l$, then $\angle 1 \cong \angle 2$. If $k \parallel n$, then $\angle 1 \cong \angle 3$. Therefore, $\angle 2 \cong \angle 3$ and $l \parallel n$. (Substitution Prop.; if 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.)

Pages 87–88 • WRITTEN EXERCISES

A 1. $\overline{AB} \parallel \overline{FC}$ 2. $\overline{AE} \parallel \overline{BD}$ 3. $\overline{AB} \parallel \overline{FC}$ 4. $\overline{FB} \parallel \overline{EC}$ 5. none

6. $\overline{AE} \parallel \overline{BD}$ 7. none 8. none 9. $\overline{AE} \parallel \overline{BD}$ 10. $\overline{AE} \parallel \overline{BD}$ 11. $\overline{AE} \parallel \overline{BD}$

12. $\overline{FB} \parallel \overline{EC}$ 13. $\overline{AE} \parallel \overline{BD}$ 14. none 15. $\overline{FB} \parallel \overline{EC}$; $\overline{AE} \parallel \overline{BD}$

16. $\overline{AB} \parallel \overline{FC}$; $\overline{AE} \parallel \overline{BD}$

17. 1. Given 2. Vert. ∠s are ≅. 3. Trans. Prop. 4. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

B 18. $(x - 40) + (x + 40) = 180$, $2x = 180$, $x = 90$; $(x - 40) + y = 180$, $(90 - 40) + y = 180$, $y = 130$

19. $3x = 105$, $x = 35$; $105 = 180 - (2y + x)$, $105 = 180 - (2y + 35)$, $2y = 40$, $y = 20$

20. $\overline{PQ} \parallel \overline{RS}$. $\angle 1 \cong \angle 2$, $\angle 2 \cong \angle 5$ (Vert. ∠s are ≅.), and $\angle 5 \cong \angle 4$, so $\angle 1 \cong \angle 4$. Since alt. int. ∠s are ≅, $\overline{PQ} \parallel \overline{RS}$.

21. $\angle 1 \cong \angle 4$; $\angle 2 \cong \angle 5$. If $\angle 3 \cong \angle 6$, then $\overline{PQ} \parallel \overline{RS}$ because alt. int. ∠s are ≅. If $\overline{PQ} \parallel \overline{RS}$, then $\angle 1 \cong \angle 4$ because they are alt. int. ∠s. $\angle 2 \cong \angle 5$ because vert. ∠s are ≅.

22.

Statements	Reasons
1. $\angle 1$ is supp. to $\angle 2$.	1. Given
2. $m\angle 2 + m\angle 3 = 180$	2. ∠ Add. Post.
3. $\angle 3$ is supp. to $\angle 2$.	3. Def. of supp. ∠s
4. $\angle 1 \cong \angle 3$	4. If 2 ∠s are supps. of the same ∠, then the 2 ∠s are ≅.
5. $k \parallel n$	5. If 2 lines are cut by a trans. and alt. int. ∠s are ≅, then the lines are ∥.

23.

Statements	Reasons
1. $k \perp t$; $n \perp t$	1. Given
2. $m\angle 1 = 90$; $m\angle 2 = 90$	2. Def. of ⊥ lines
3. $m\angle 1 = m\angle 2$, or $\angle 1 \cong \angle 2$	3. Substitution Prop.
4. $k \parallel n$	4. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

24.

Statements	Reasons
1. $\overline{BE}$ bisects $\angle DBA$.	1. Given
2. $\angle 2 \cong \angle 3$	2. Def. of $\angle$ bis.
3. $\angle 3 \cong \angle 1$	3. Given
4. $\angle 2 \cong \angle 1$	4. Trans. Prop.
5. $\overline{CD} \parallel \overline{BE}$	5. If 2 lines are cut by a trans. and alt. int. $\angle$s are $\cong$, then the lines are $\parallel$.

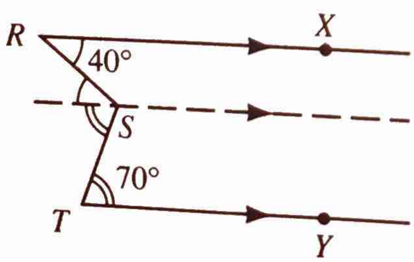
25.

Statements	Reasons
1. $\overline{BE} \perp \overline{DA}$; $\overline{CD} \perp \overline{DA}$	1. Given
2. $\overline{CD} \parallel \overline{BE}$	2. In a plane, 2 lines $\perp$ to the same line are $\parallel$.
3. $\angle 1 \cong \angle 2$	3. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.

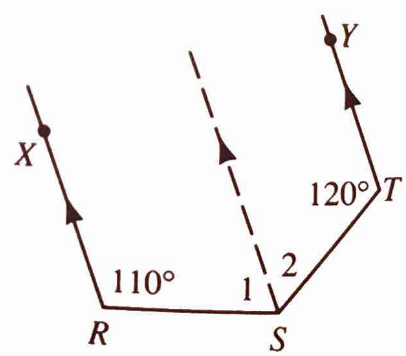
26.

Statements	Reasons
1. $\angle C \cong \angle 3$	1. Given
2. $\overline{CD} \parallel \overline{BE}$	2. If 2 lines are cut by a trans. and corr. $\angle$s are $\cong$, then the lines are $\parallel$.
3. $\overline{BE} \perp \overline{DA}$	3. Given
4. $\overline{CD} \perp \overline{DA}$	4. If a trans. is $\perp$ to one of 2 $\parallel$ lines, then it is $\perp$ to the other one also.

27. $m\angle RST = 40 + 70 = 110$



28. $m\angle 1 = 70$, $m\angle 2 = 60$, $m\angle RST = 130$

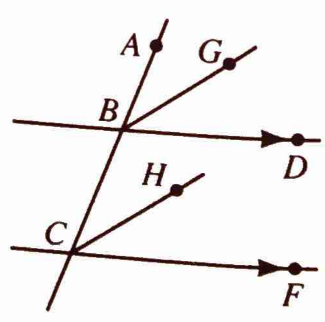


29. $2x = 5y$, $x - y = 30$; $x = 30 + y$, $2(30 + y) = 5y$; $60 + 2y = 5y$, $3y = 60$, $y = 20$; $x - y = 30$, $x - 20 = 30$, $x = 50$

C 30. The bisectors appear to be $\parallel$.

Given: $\overleftrightarrow{BD} \parallel \overleftrightarrow{CF}$; $\overrightarrow{BG}$ bisects $\angle ABD$; $\overrightarrow{CH}$ bisects $\angle BCF$.

Prove: $\overrightarrow{BG} \parallel \overrightarrow{CH}$



Statements	Reasons
1. $\overleftrightarrow{BD} \parallel \overleftrightarrow{CF}$	1. Given
2. $m\angle ABD = m\angle BCF$	2. If 2 lines are cut by a trans., then corr. ∠s are ≅.
3. $\frac{1}{2}m\angle ABD = \frac{1}{2}m\angle BCF$	3. Mult. Prop. of =
4. $\overrightarrow{BG}$ bisects $\angle ABD$; $\overrightarrow{CH}$ bisects $\angle BCF$.	4. Given
5. $m\angle ABG = \frac{1}{2}m\angle ABD$; $m\angle BCH = \frac{1}{2}m\angle BCF$	5. ∠ Bis. Thm.
6. $m\angle ABG = m\angle BCH$	6. Substitution Prop.
7. $\overrightarrow{BG} \parallel \overrightarrow{CH}$	7. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

31. $x^2 + 3x = 180$; $x^2 + 3x - 180 = 0$; $(x + 15)(x - 12) = 0$; $x + 15 = 0$ or $x - 12 = 0$; $x = -15$ (reject) or $x = 12$; $x = 12$

Page 89 • SELF-TEST 1

1. sometimes **2.** never **3.** always **4.** sometimes **5.** always
6. ∠3, ∠6; ∠4, ∠5 **7.** Answers may vary; ∠1, ∠5; ∠2, ∠6; ∠3, ∠7; ∠4, ∠8
8. ∠3, ∠5 or ∠4, ∠6 **9.** ∠4; ∠3 **10.** ∠2, ∠8; ∠4, ∠7 **11.** ∠2, ∠8 **12.** 65; 115
13. $\overline{EB} \parallel \overline{DC}$ **14.** none **15.** $\overline{AE} \parallel \overline{BD}$ **16.** one, one

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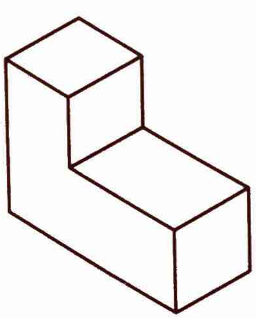
The sum of the measures of the ∠s inside the △ is 180. The sum of the measures of the ∠s outside the △ is 360.

Page 92 • APPLICATION

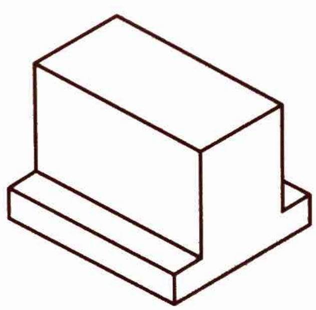
1.



2. d

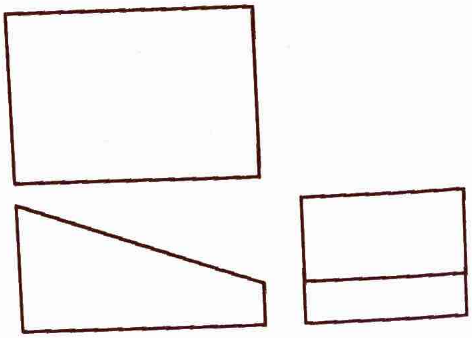
3. b

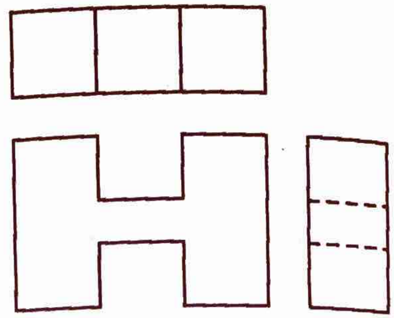
4.



5. c

6. a

7. 

8. 

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1. sometimes 2. always 3. never 4. sometimes

5. The sums of the meas. of the 2 $\angle$s in each $\triangle$ are $=$. The meas. of the third $\angle$ in each $\triangle$ must $= 180 -$ sum.

6. Let meas. of each $\angle = x$; $3x = 180$, $x = 60$

7. In $\triangle ABC$, if $m\angle A \geq 90$ and $m\angle B \geq 90$, then $m\angle A + m\angle B + m\angle C > 180$ since $m\angle C > 0$.

8. In $\triangle ABC$, if $m\angle C = 90$, then $m\angle A + m\angle B = 180 - 90 = 90$.

9. $x = 90$ 10. $x = 105$ 11. $x = 35 + (180 - 140) = 75$

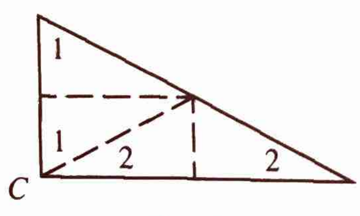
12. The bis. of $\angle J$ may not contain the midpt. of $\overline{PE}$.

13. The line through $P \perp$ to $\overline{JE}$ may not contain the midpt. of $\overline{JE}$.

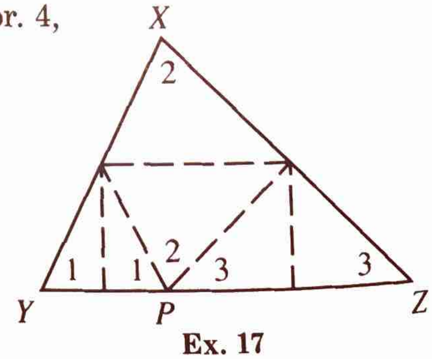
14. $\overleftrightarrow{PX}$ may not be $\parallel$ to $\overleftrightarrow{JE}$.

15. By the Substitution Prop., $m\angle 1 + m\angle 2 + m\angle 3 = m\angle 3 + m\angle 4$. By the Subtraction Prop. of $=$, $m\angle 1 + m\angle 2 = m\angle 4$, which proves Thm. 3-12.

16. $m\angle 1 + m\angle 2 = 90$, so this illustrates Cor. 4, the acute $\angle$s of a rt. $\triangle$ are comp.



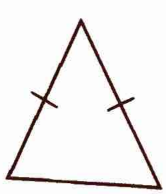
Ex. 16

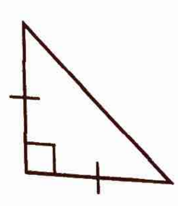


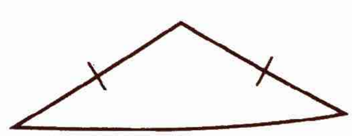
Ex. 17

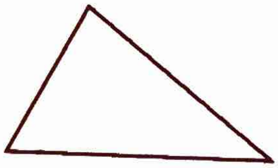
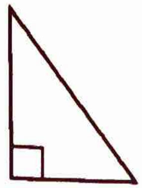
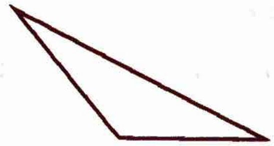
17. $m\angle 1 + m\angle 2 + m\angle 3 = 180$, so this illustrates Thm. 3-11, the sum of the meas. of the $\angle$s of a $\triangle$ is 180.

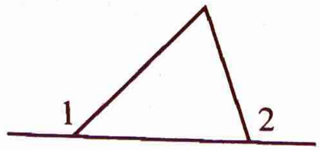
Pages 97–99 • WRITTEN EXERCISES

A 1. a. 

b. 

c. 

2. a.  b.  c. 

3. not possible 4. 

5. 180 6. 30 7. 95 8. $x + (x - 20) = 80; x = 50$

9. $4x + 30 = 6x - 20; x = 25$

10. $m\angle 9 + m\angle 10 + m\angle 11 = (m\angle 7 + m\angle 8) + (m\angle 6 + m\angle 8) + (m\angle 6 + m\angle 7) = 2(m\angle 6 + m\angle 7 + m\angle 8) = 2 \cdot 180 = 360$

11. $x = 30; y = 50 + 30 = 80$ 12. $x = 110; y = 110 - 40 = 70$

13. $x = 40; y = 90 - 40 = 50$

B 14. $x = 65 + 25 = 90; y = 90 - 65 = 25$

15. $y = 90 - 40 = 50; x = 90 - 50 = 40$

16. $y = 90 - (40 + 20) = 30; x + 30 = 90 - 20, x = 40$

17. Yes; $4n = 2n + 10; n = 5$; the sides are $4(5) = 20, 2(5) + 10 = 20, 7(5) - 15 = 20$.

18. a. $3t = 5t - 12, t = 6; 3t = t + 20, t = 10; 5t - 12 = t + 20, t = 8$

b. No; there is no value of t such that $3t = 5t - 12 = t + 20$.

19. Let x be the measure of the smallest angle; $x + 2x + 3x = 180; 6x = 180; x = 30$; the meas. of the angles are 30, 60, 90.

20. $x + (x + 28) + 2x = 180; 4x + 28 = 180; 4x = 152; x = 38$; 38, 66, 76

21. $m\angle A + m\angle B + m\angle C = 180; m\angle A + m\angle B < 120$, so $m\angle C > 60$.

22. $m\angle R + m\angle S + m\angle T = 180; m\angle R + m\angle S > 110$, so $m\angle T < 70$.

23. a. 22 b. 23 c. $\angle ABD$ and $\angle C$ are comps. of $\angle CBD$.

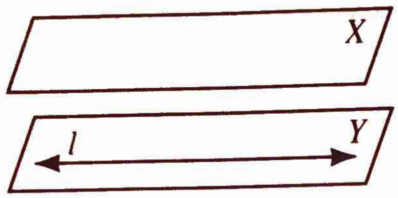
24. a. 130 b. 130 c. If $m\angle E = 80$, then $m\angle FIG$ will always be 130.

25.

Statements	Reasons
1. $\angle ABD \cong \angle AED$	1. Given
2. $\angle A \cong \angle A$	2. Refl. Prop.
3. $\angle C \cong \angle F$	3. If 2 $\angle$s of one $\triangle$ are $\cong$ to 2 $\angle$s of another $\triangle$, then the third $\angle$s are $\cong$.

26. $m\angle MTR = 180 - 85 = 95; m\angle STR = 180 - (30 + 95) = 55;$
$m\angle 1 = 90 - 55 = 35; m\angle NRT = 55; m\angle 2 = 180 - 55 = 125$

42.



Page 78 • EXPLORATIONS

$\cong$ $\angle$s: corr. $\angle$s, alt. int. $\angle$s, vert. $\angle$s, alt. ext. $\angle$s
supp. $\angle$s: s-s. int. $\angle$s, s-s. ext. $\angle$s, adj. $\angle$s

Page 80 • CLASSROOM EXERCISES

1. $l \parallel p$ 2. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
3. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
4. If 2 $\parallel$ lines are cut by a trans., then s-s. int. $\angle$s are supp.
5. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
6. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$. 7. Vert. $\angle$s are $\cong$.
8. If a trans. is $\perp$ to one of two $\parallel$ lines, then it is $\perp$ to the other one also.
9. If 2 $\parallel$ lines are cut by a trans., then s-s. int. $\angle$s are supp.
10. $m\angle 4 = m\angle 5 = m\angle 8 = 130$; $m\angle 2 = m\angle 3 = m\angle 6 = m\angle 7 = 50$
11. $m\angle 4 = m\angle 5 = m\angle 8 = x$; $m\angle 2 = m\angle 3 = m\angle 6 = m\angle 7 = 180 - x$
12. $m\angle 3 + m\angle 4 = 180$; $3m\angle 3 = 180$; $m\angle 3 = 60$, so $m\angle 6 = 60$
13. $m\angle 5 + m\angle 6 = 180$; $2m\angle 6 + 20 = 180$; $m\angle 6 = 80 = m\angle 2$; $m\angle 1 = 100$
14. In Step 2 he used Thm. 3-2, which relies on Post. 10.

Pages 80–82 • WRITTEN EXERCISES

A 1. $\angle 3, \angle 6, \angle 8$ 2. $\angle 6, \angle 9, \angle 14$ 3. $\angle 4, \angle 5, \angle 7, \angle 10, \angle 12, \angle 13, \angle 15$
4. $\angle 1, \angle 3, \angle 6, \angle 8, \angle 9, \angle 11, \angle 14, \angle 16$ 5. 110, 70 6. x, $180 - x$
7. $x = 60$, $y = 61$ 8. $4x + 14x = 180$, $x = 10$; $2y = 90$; $y = 45$
9. $120 + x = 180$, $x = 60$; $60 = 3y + 6$, $y = 18$
10. $x = 70$; $50 + 70 + y = 180$, $y = 60$
11. $3x = 42$, $x = 14$; $3(14) + 6y - 6 = 90$, $y = 9$
12. $x = 55$; $y + 55 + 50 = 180$, $y = 75$
13. 1. Given 2. Def. of $\perp$ lines 3. $l \parallel n$ 4. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$. 5. $m\angle 2 = 90$ 6. Def. of $\perp$ lines
B 14. $x = 56$; $56 + 24 + y = 180$, $y = 100$; $56 + 24 + 4z = 180$, $z = 25$
15. $x = 70$; $5y + 10 = 70$, $y = 12$; $z + 32 = 5(12) + 10$, $z = 38$

16. $3x = 90$, $x = 30$; $8y + 4 = 68$, $y = 8$; $2z + 8(8) + 4 = 90$, $z = 11$

17. **a.** $m\angle DAB + 116 = 180$, $m\angle DAB = 64$; $m\angle KAB = 32$; $m\angle DKA = 32$

b. More information is needed.

18. $2x + y = 60$, $2x - y = 40$; $4x = 100$, $x = 25$; $y = 10$

19. $4x - 2y = 110$, $4x + 2y = 130$; $8x = 240$, $x = 30$; $y = 5$

20.

Statements	Reasons
1. $k \parallel l$	1. Given
2. $\angle 2 \cong \angle 4$	2. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
3. $\angle 4 \cong \angle 7$	3. Vert. $\angle$s are $\cong$.
4. $\angle 2 \cong \angle 7$	4. Trans. Prop.

21.

Statements	Reasons
1. $k \parallel l$	1. Given
2. $\angle 1 \cong \angle 8$, or $m\angle 1 = m\angle 8$	2. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
3. $m\angle 8 + m\angle 7 = 180$	3. $\angle$ Add. Post.
4. $m\angle 1 + m\angle 7 = 180$	4. Substitution Prop.
5. $\angle 1$ is supp. to $\angle 7$.	5. Def. of supp. $\angle$s

22.

Statements	Reasons
1. $k \parallel n$	1. Given
2. $\angle 1 \cong \angle 2$, or $m\angle 1 = m\angle 2$	2. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
3. $m\angle 2 + m\angle 4 = 180$	3. $\angle$ Add. Post.
4. $m\angle 1 + m\angle 4 = 180$	4. Substitution Prop.
5. $\angle 1$ is supp. to $\angle 4$.	5. Def. of supp. $\angle$s

23. **a.**

Statements	Reasons
1. $\overline{AB} \parallel \overline{DC}$; $\overline{AD} \parallel \overline{BC}$	1. Given
2. $\angle A$ is supp. to $\angle B$; $\angle C$ is supp. to $\angle B$.	2. If 2 $\parallel$ lines are cut by a trans., then s-s. int. $\angle$s are supp.
3. $\angle A \cong \angle C$	3. If 2 $\angle$s are supps. of the same $\angle$, then the 2 $\angle$s are $\cong$.

b. Yes, by the same reasoning as in part (a).

C **24.**

Statements	Reasons
1. $\overline{AS} \parallel \overline{BT}$	1. Given
2. $m\angle 1 = m\angle 4$	2. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
3. $m\angle 2 = m\angle 5$	3. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
4. $m\angle 4 = m\angle 5$	4. Given
5. $m\angle 1 = m\angle 2$	5. Substitution Prop.
6. $\overrightarrow{SA}$ bisects $\angle BSR$.	6. Def. of $\angle$ bis.

25. Steps 1–5 of the proof in Ex. 24 prove that $m\angle 1 = m\angle 2$. $\overrightarrow{SB}$ bisects $\angle AST$, so $m\angle 2 = m\angle 3$. Since $m\angle 1 + m\angle 2 + m\angle 3 = 180$, $3m\angle 1 = 180$ by Substitution, and $m\angle 1 = 60$.

Page 82 • MIXED REVIEW EXERCISES

1. **a.** True **b.** If 2 lines form $\cong$ adj. $\angle$s, then the lines are $\perp$. **c.** True
2. **a.** True **b.** If 2 lines are not skew, then they are $\parallel$. **c.** False
3. **a.** True **b.** If 2 $\angle$s are supp., then the sum of their measures is 180. **c.** True
4. **a.** True **b.** If 2 planes do not intersect, then they are $\parallel$. **c.** True

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1. $\overline{KC} \parallel \overline{DE}$. If 2 lines are cut by a trans. and s-s. int. $\angle$s are supp., then the lines are $\parallel$.
2. $\overline{OX} \parallel \overline{IZ}$. If 2 lines are cut by a trans. and corr. $\angle$s are $\cong$, then the lines are $\parallel$.
3. $\overline{LA} \parallel \overline{TS}$. If 2 lines are cut by a trans. and s-s. int. $\angle$s are supp., then the lines are $\parallel$.
4. $\overline{GA} \parallel \overline{EM}$. If 2 lines are cut by a trans. and alt. int. $\angle$s are $\cong$, then the lines are $\parallel$.
5. $\overline{PL} \parallel \overline{AR}$ **6.** $\overline{PA} \parallel \overline{LR}$ **7.** no segs. $\parallel$ **8.** $\overline{PL} \parallel \overline{AR}$ **9.** no segs. $\parallel$
10. $\overline{PL} \parallel \overline{AR}$ **11.** $\overline{PA} \parallel \overline{LR}$
12. Through a pt. outside a line, there is a line $\parallel$ to the given line. Through a pt. outside a line, there is no more than one line $\parallel$ to the given line.
13. Through a point outside a line, there is a line $\perp$ to the given line. Through a point outside a line, there is no more than one line $\perp$ to the given line.
14. one **15.** one **16.** one **17.** one; Protractor Post. **18.** Infinitely many

19. **a.** False **b.** True **c.** True **d.** True

20. If $k \parallel l$, then $\angle 1 \cong \angle 2$. If $k \parallel n$, then $\angle 1 \cong \angle 3$. Therefore, $\angle 2 \cong \angle 3$ and $l \parallel n$. (Substitution Prop.; if 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.)

Pages 87–88 • WRITTEN EXERCISES

A 1. $\overline{AB} \parallel \overline{FC}$ 2. $\overline{AE} \parallel \overline{BD}$ 3. $\overline{AB} \parallel \overline{FC}$ 4. $\overline{FB} \parallel \overline{EC}$ 5. none
6. $\overline{AE} \parallel \overline{BD}$ 7. none 8. none 9. $\overline{AE} \parallel \overline{BD}$ 10. $\overline{AE} \parallel \overline{BD}$ 11. $\overline{AE} \parallel \overline{BD}$
12. $\overline{FB} \parallel \overline{EC}$ 13. $\overline{AE} \parallel \overline{BD}$ 14. none 15. $\overline{FB} \parallel \overline{EC}$; $\overline{AE} \parallel \overline{BD}$
16. $\overline{AB} \parallel \overline{FC}$; $\overline{AE} \parallel \overline{BD}$
17. 1. Given 2. Vert. ∠s are ≅. 3. Trans. Prop. 4. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

B 18. $(x - 40) + (x + 40) = 180$, $2x = 180$, $x = 90$; $(x - 40) + y = 180$, $(90 - 40) + y = 180$, $y = 130$

19. $3x = 105$, $x = 35$; $105 = 180 - (2y + x)$, $105 = 180 - (2y + 35)$, $2y = 40$, $y = 20$

20. $\overline{PQ} \parallel \overline{RS}$. $\angle 1 \cong \angle 2$, $\angle 2 \cong \angle 5$ (Vert. ∠s are ≅.), and $\angle 5 \cong \angle 4$, so $\angle 1 \cong \angle 4$. Since alt. int. ∠s are ≅, $\overline{PQ} \parallel \overline{RS}$.

21. $\angle 1 \cong \angle 4$; $\angle 2 \cong \angle 5$. If $\angle 3 \cong \angle 6$, then $\overline{PQ} \parallel \overline{RS}$ because alt. int. ∠s are ≅. If $\overline{PQ} \parallel \overline{RS}$, then $\angle 1 \cong \angle 4$ because they are alt. int. ∠s. $\angle 2 \cong \angle 5$ because vert. ∠s are ≅.

22.

Statements	Reasons
1. $\angle 1$ is supp. to $\angle 2$.	1. Given
2. $m\angle 2 + m\angle 3 = 180$	2. ∠ Add. Post.
3. $\angle 3$ is supp. to $\angle 2$.	3. Def. of supp. ∠s
4. $\angle 1 \cong \angle 3$	4. If 2 ∠s are supps. of the same ∠, then the 2 ∠s are ≅.
5. $k \parallel n$	5. If 2 lines are cut by a trans. and alt. int. ∠s are ≅, then the lines are ∥.

23.

Statements	Reasons
1. $k \perp t$; $n \perp t$	1. Given
2. $m\angle 1 = 90$; $m\angle 2 = 90$	2. Def. of ⊥ lines
3. $m\angle 1 = m\angle 2$, or $\angle 1 \cong \angle 2$	3. Substitution Prop.
4. $k \parallel n$	4. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

24.

Statements	Reasons
1. $\overline{BE}$ bisects $\angle DBA$.	1. Given
2. $\angle 2 \cong \angle 3$	2. Def. of $\angle$ bis.
3. $\angle 3 \cong \angle 1$	3. Given
4. $\angle 2 \cong \angle 1$	4. Trans. Prop.
5. $\overline{CD} \parallel \overline{BE}$	5. If 2 lines are cut by a trans. and alt. int. $\measuredangle$s are $\cong$, then the lines are $\parallel$.

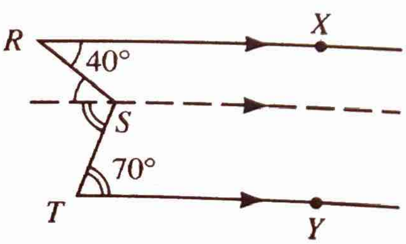
25.

Statements	Reasons
1. $\overline{BE} \perp \overline{DA}$; $\overline{CD} \perp \overline{DA}$	1. Given
2. $\overline{CD} \parallel \overline{BE}$	2. In a plane, 2 lines $\perp$ to the same line are $\parallel$.
3. $\angle 1 \cong \angle 2$	3. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\measuredangle$s are $\cong$.

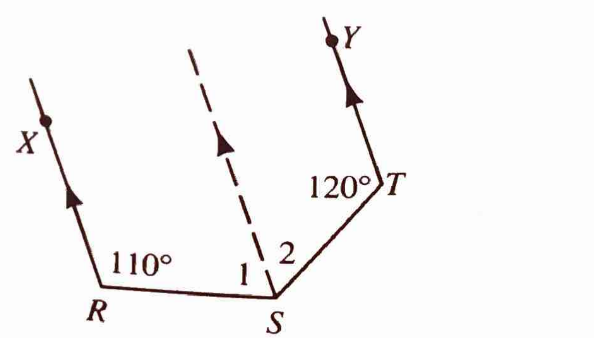
26.

Statements	Reasons
1. $\angle C \cong \angle 3$	1. Given
2. $\overline{CD} \parallel \overline{BE}$	2. If 2 lines are cut by a trans. and corr. $\measuredangle$s are $\cong$, then the lines are $\parallel$.
3. $\overline{BE} \perp \overline{DA}$	3. Given
4. $\overline{CD} \perp \overline{DA}$	4. If a trans. is $\perp$ to one of 2 $\parallel$ lines, then it is $\perp$ to the other one also.

27. $m\angle RST = 40 + 70 = 110$



28. $m\angle 1 = 70$, $m\angle 2 = 60$, $m\angle RST = 130$

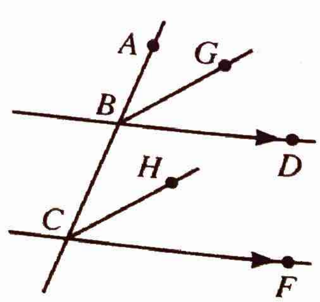


29. $2x = 5y$, $x - y = 30$; $x = 30 + y$, $2(30 + y) = 5y$; $60 + 2y = 5y$, $3y = 60$, $y = 20$; $x - y = 30$, $x - 20 = 30$, $x = 50$

C **30.** The bisectors appear to be $\parallel$.

Given: $\overleftrightarrow{BD} \parallel \overleftrightarrow{CF}$; $\overrightarrow{BG}$ bisects $\angle ABD$; $\overrightarrow{CH}$ bisects $\angle BCF$.

Prove: $\overrightarrow{BG} \parallel \overrightarrow{CH}$



Statements	Reasons
1. $\overleftrightarrow{BD} \parallel \overleftrightarrow{CF}$	1. Given
2. $m\angle ABD = m\angle BCF$	2. If 2 lines are cut by a trans., then corr. ∠s are ≅.
3. $\frac{1}{2}m\angle ABD = \frac{1}{2}m\angle BCF$	3. Mult. Prop. of =
4. $\overrightarrow{BG}$ bisects $\angle ABD$; $\overrightarrow{CH}$ bisects $\angle BCF$.	4. Given
5. $m\angle ABG = \frac{1}{2}m\angle ABD$; $m\angle BCH = \frac{1}{2}m\angle BCF$	5. ∠ Bis. Thm.
6. $m\angle ABG = m\angle BCH$	6. Substitution Prop.
7. $\overrightarrow{BG} \parallel \overrightarrow{CH}$	7. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

31. $x^2 + 3x = 180$; $x^2 + 3x - 180 = 0$; $(x + 15)(x - 12) = 0$; $x + 15 = 0$ or $x - 12 = 0$; $x = -15$ (reject) or $x = 12$; $x = 12$

Page 89 • SELF-TEST 1

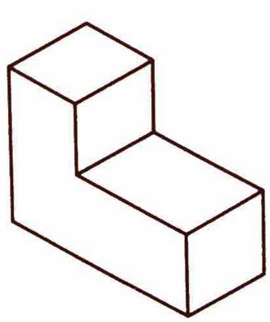
1. sometimes **2.** never **3.** always **4.** sometimes **5.** always
6. ∠3, ∠6; ∠4, ∠5 **7.** Answers may vary; ∠1, ∠5; ∠2, ∠6; ∠3, ∠7; ∠4, ∠8
8. ∠3, ∠5 or ∠4, ∠6 **9.** ∠4; ∠3 **10.** ∠2, ∠8; ∠4, ∠7 **11.** ∠2, ∠8 **12.** 65; 115
13. $\overline{EB} \parallel \overline{DC}$ **14.** none **15.** $\overline{AE} \parallel \overline{BD}$ **16.** one, one

Page 89 • EXPLORATIONS

The sum of the measures of the ∠s inside the △ is 180. The sum of the measures of the ∠s outside the △ is 360.

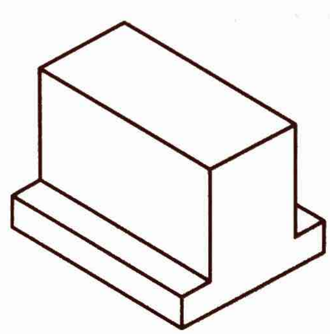
Page 92 • APPLICATION

1.



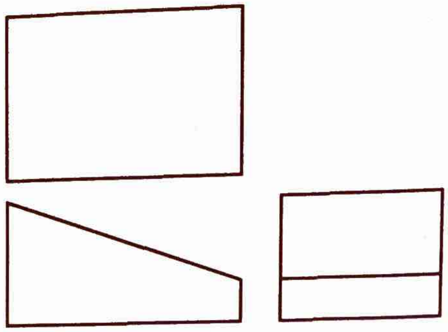
2. d
3. b

4.

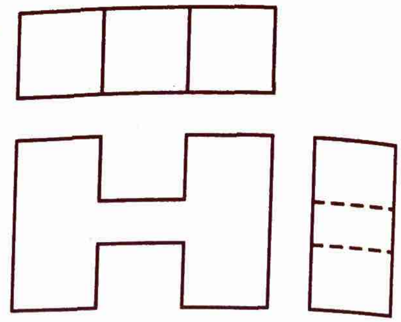


5. c
6. a

7.



8.



Page 96 • CLASSROOM EXERCISES

1. sometimes 2. always 3. never 4. sometimes

5. The sums of the meas. of the 2 $\angle$s in each $\triangle$ are $=$. The meas. of the third $\angle$ in each $\triangle$ must $= 180 -$ sum.

6. Let meas. of each $\angle = x$; $3x = 180$, $x = 60$

7. In $\triangle ABC$, if $m\angle A \geq 90$ and $m\angle B \geq 90$, then $m\angle A + m\angle B + m\angle C > 180$ since $m\angle C > 0$.

8. In $\triangle ABC$, if $m\angle C = 90$, then $m\angle A + m\angle B = 180 - 90 = 90$.

9. $x = 90$ 10. $x = 105$ 11. $x = 35 + (180 - 140) = 75$

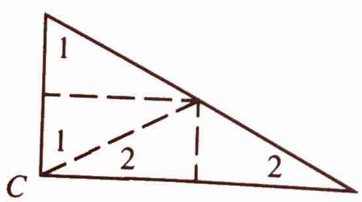
12. The bis. of $\angle J$ may not contain the midpt. of $\overline{PE}$.

13. The line through $P \perp$ to $\overline{JE}$ may not contain the midpt. of $\overline{JE}$.

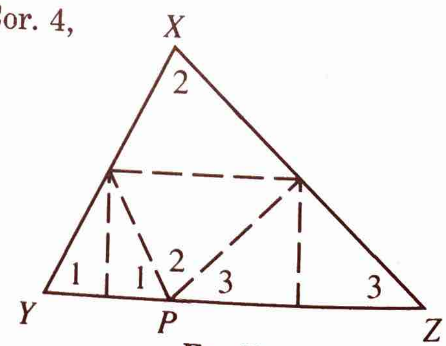
14. $\overleftrightarrow{PX}$ may not be $\parallel$ to $\overleftrightarrow{JE}$.

15. By the Substitution Prop., $m\angle 1 + m\angle 2 + m\angle 3 = m\angle 3 + m\angle 4$. By the Subtraction Prop. of $=$, $m\angle 1 + m\angle 2 = m\angle 4$, which proves Thm. 3-12.

16. $m\angle 1 + m\angle 2 = 90$, so this illustrates Cor. 4, the acute $\angle$s of a rt. $\triangle$ are comp.



Ex. 16

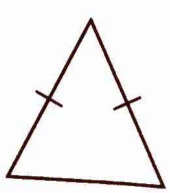


Ex. 17

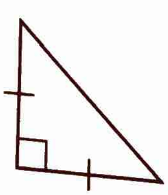
17. $m\angle 1 + m\angle 2 + m\angle 3 = 180$, so this illustrates Thm. 3-11, the sum of the meas. of the $\angle$s of a $\triangle$ is 180.

Pages 97–99 • WRITTEN EXERCISES

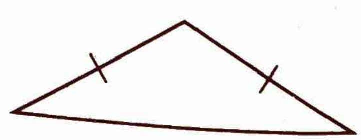
A 1. a.

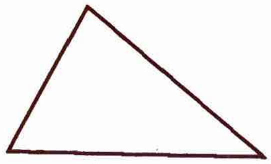
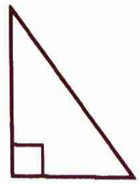
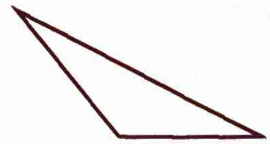


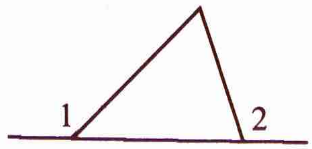
b.



c.



2. a.  **b.**  **c.** 

3. not possible **4.** 

5. 180 **6.** 30 **7.** 95 **8.** $x + (x - 20) = 80; x = 50$

9. $4x + 30 = 6x - 20; x = 25$

10. $m\angle 9 + m\angle 10 + m\angle 11 = (m\angle 7 + m\angle 8) + (m\angle 6 + m\angle 8) + (m\angle 6 + m\angle 7) = 2(m\angle 6 + m\angle 7 + m\angle 8) = 2 \cdot 180 = 360$

11. $x = 30; y = 50 + 30 = 80$ **12.** $x = 110; y = 110 - 40 = 70$

13. $x = 40; y = 90 - 40 = 50$

B **14.** $x = 65 + 25 = 90; y = 90 - 65 = 25$

15. $y = 90 - 40 = 50; x = 90 - 50 = 40$

16. $y = 90 - (40 + 20) = 30; x + 30 = 90 - 20, x = 40$

17. Yes; $4n = 2n + 10; n = 5$; the sides are $4(5) = 20, 2(5) + 10 = 20, 7(5) - 15 = 20$.

18. a. $3t = 5t - 12, t = 6; 3t = t + 20, t = 10; 5t - 12 = t + 20, t = 8$

b. No; there is no value of t such that $3t = 5t - 12 = t + 20$.

19. Let x be the measure of the smallest angle; $x + 2x + 3x = 180; 6x = 180; x = 30$; the meas. of the angles are 30, 60, 90.

20. $x + (x + 28) + 2x = 180; 4x + 28 = 180; 4x = 152; x = 38$; 38, 66, 76

21. $m\angle A + m\angle B + m\angle C = 180; m\angle A + m\angle B < 120$, so $m\angle C > 60$.

22. $m\angle R + m\angle S + m\angle T = 180; m\angle R + m\angle S > 110$, so $m\angle T < 70$.

23. a. 22 **b.** 23 **c.** $\angle ABD$ and $\angle C$ are comps. of $\angle CBD$.

24. a. 130 **b.** 130 **c.** If $m\angle E = 80$, then $m\angle FIG$ will always be 130.

25.

Statements	Reasons
1. $\angle ABD \cong \angle AED$	1. Given
2. $\angle A \cong \angle A$	2. Refl. Prop.
3. $\angle C \cong \angle F$	3. If 2 $\angle$s of one $\triangle$ are $\cong$ to 2 $\angle$s of another $\triangle$, then the third $\angle$s are $\cong$.

26. $m\angle MTR = 180 - 85 = 95; m\angle STR = 180 - (30 + 95) = 55;$ $m\angle 1 = 90 - 55 = 35; m\angle NRT = 55; m\angle 2 = 180 - 55 = 125$

27. Given: $\triangle ABC$

Prove: $m\angle 1 + m\angle 2 + m\angle 3 = 180$

Statements	Reasons
1. Draw $\overrightarrow{CD}$ through $C \parallel$ to $\overleftrightarrow{AB}$.	1. Through a pt. outside a line, there is exactly 1 line $\parallel$ to the given line.
2. $\angle 2 \cong \angle 5$, or $m\angle 2 = m\angle 5$	2. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
3. $\angle 1 \cong \angle 4$, or $m\angle 1 = m\angle 4$	3. If 2 $\parallel$ lines are cut by a trans., then corr. $\angle$s are $\cong$.
4. $m\angle ACD + m\angle 4 = 180$; $m\angle ACD = m\angle 3 + m\angle 5$	4. $\angle$ Add. Post.
5. $m\angle 3 + m\angle 4 + m\angle 5 = 180$	5. Substitution Prop.
6. $m\angle 1 + m\angle 2 + m\angle 3 = 180$	6. Substitution Prop.

28.

Statements	Reasons
1. $m\angle JGI = m\angle H + m\angle I$	1. The meas. of an ext. $\angle$ of a $\triangle$ = the sum of the meas. of the 2 remote int. $\angle$s.
2. $m\angle H = m\angle I$	2. Given
3. $m\angle JGI = 2m\angle H$	3. Substitution Prop.
4. $\frac{1}{2}m\angle JGI = m\angle H$	4. Div. Prop. of =
5. $\overrightarrow{GK}$ bisects $\angle JGI$.	5. Given
6. $m\angle 1 = \frac{1}{2}m\angle JGI$	6. $\angle$ Bis. Thm.
7. $m\angle 1 = m\angle H$	7. Substitution Prop.
8. $\overline{GK} \parallel \overline{HI}$	8. If 2 lines are cut by a trans. and corr. $\angle$s are $\cong$, then the lines are $\parallel$.

29. $2x + y + 125 = 180$, $2x + y = 55$, $y = 55 - 2x$; $(x + 2y) + (2x + y) = 90$, $(x + 2y) + 55 = 90$, $x + 2y = 35$; $x + 2(55 - 2x) = 35$, $x + 110 - 4x = 35$, $3x = 75$, $x = 25$; $2x + y = 55$, $50 + y = 55$, $y = 5$

30. $(5x + y) + (5x - y) + 100 = 180$, $10x = 80$, $x = 8$; $2x + y = 5x - y$, $2y = 3x$, $2y = 24$, $y = 12$

31. $\angle 1 \cong \angle 2 \cong \angle 5$; $\angle 3 \cong \angle 4 \cong \angle 6$

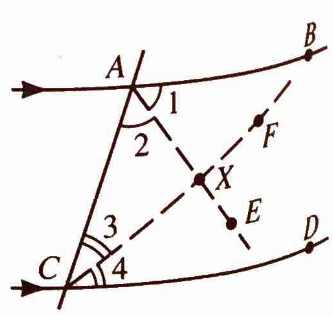
C **32.** $\angle 7 \cong \angle 8$, $\angle 11 \cong \angle 12$

33. **a–b.** Check students' drawings. See figure at the right.

c. The angle measures 90, so the bisectors are $\perp$.

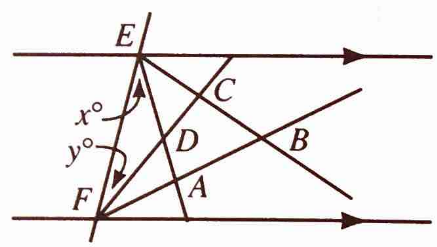
d. Given: $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$; $\overrightarrow{AE}$ bisects $\angle BAC$; $\overrightarrow{CF}$ bisects $\angle ACD$.

Prove: $\overleftrightarrow{AE} \perp \overleftrightarrow{CF}$



Statements	Reasons
1. $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$	1. Given
2. $m\angle BAC + m\angle ACD = 180$	2. If 2 ∥ lines are cut by a trans., then s-s. int. ∠s are supp.; def. of supp. ∠s
3. $\frac{1}{2}m\angle BAC + \frac{1}{2}m\angle ACD = 90$	3. Div. Prop. of =
4. $\overrightarrow{AE}$ bisects $\angle BAC$; $\overrightarrow{CF}$ bisects $\angle ACD$.	4. Given
5. $m\angle 2 = \frac{1}{2}m\angle BAC$; $m\angle 3 = \frac{1}{2}m\angle ACD$	5. ∠ Bis. Thm.
6. $m\angle 2 + m\angle 3 = 90$	6. Substitution Prop.
7. $m\angle AXF = m\angle 2 + m\angle 3$	7. The meas. of an ext. ∠ of a △ = the sum of the meas. of the 2 remote int. ∠s
8. $m\angle AXF = 90$	8. Substitution Prop.
9. $\overleftrightarrow{AE} \perp \overleftrightarrow{CF}$	9. Def. of ⊥ lines

34. Since $3x$ and $3y$ are meas. of s-s. int. ∠s, $3x + 3y = 180$, and $x + y = 60$. Then $m\angle EDF = m\angle CDA = 180 - (x + y) = 120$. $\angle EBF$ is the third ∠ of a △ with ∠s of meas. $2x$ and $2y$, so $m\angle CBA = 180 - (2x + 2y) = 180 - 120 = 60$. Then, in $ABCD$, $m\angle CDA + m\angle CBA = 120 + 60 = 180$. Also, $\angle BCD$ is an ext. ∠ of $\triangle ECF$ with remote int. ∠s of meas. $2x$ and y, so $m\angle BCD = 2x + y$. Similarly, $m\angle BAD = 2y + x$. So, $m\angle BCD + m\angle BAD = 3x + 3y = 180$. Therefore, in $ABCD$ opp. ∠s are supp.



Page 99 • EXPLORATIONS

1–4. Sketches and angle measures will vary. **1.** False; true for acute △s **2.** False; true for acute △s **3.** True **4.** False; true for rt. △s

Page 103 • CLASSROOM EXERCISES

1. convex polygon **2.** nonconvex polygon **3.** not a polygon **4.** nonconvex polygon **5.** not a polygon **6.** nonconvex polygon **7.** It has the same shape. **8.** $(102 - 2)180 = 18{,}000$; 360

9.

No. of sides	6	10	20	36	18	360	4
Meas. of each ext. ∠	60	36	18	10	20	1	90
Meas. of each int. ∠	120	144	162	170	160	179	90

Pages 104–105 • WRITTEN EXERCISES

A **1.** $(4 - 2)180 = 360$; 360 **2.** $(5 - 2)180 = 540$; 360 **3.** $(6 - 2)180 = 720$; 360

4. $(8 - 2)180 = 1080$; 360 **5.** $(10 - 2)180 = 1440$; 360 **6.** $(n - 2)180$; 360

7. 360; yes

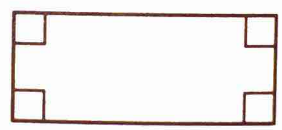
8.

No. of sides	9	15	30	60	45	24	180
Meas. of each ext. ∠	40	24	12	6	8	15	2
Meas. of each int. ∠	140	156	168	174	172	165	178

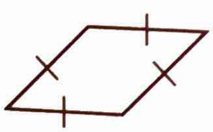
9. Let x = meas. of each of the 2 ≅ ∠s. $2x + 3(90) = (5 - 2)180$, $2x + 270 = 540$, $2x = 270$, $x = 135$

10. Let x = meas. of the fifth ∠. $x + 40 + 80 + 115 + 165 = (5 - 2)180$, $x + 400 = 540$, $x = 140$

11. 120 **12–15.** Sketches may vary. **12.**



13.



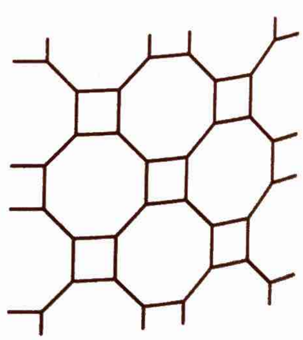
14. not possible

15. not possible (An ext. ∠ would have meas. 50, and 360 is not a multiple of 50.)

B **16.** Let n = number of sides; $(n - 2)180 = 5(360)$, $n = 12$.

17. Let n = number of sides; $\frac{(n - 2)180}{n} = 11\left(\frac{360}{n}\right)$, $n = 24$.

18. **a.** 108 **b.** No (360 is not a multiple of 108.) **19.**



Ex. 19

20. The sum of the meas. of the int. ∠s of 2 hexagons and 1 pentagon at any common vertex is $120 + 120 + 108 = 348$. A sum of 360 is necessary to tile a plane.

21. $x + 2x + 3x + 4x = (4 - 2)180$, $10x = 360$, $x = 36$; $m\angle A = 36$, $m\angle B = 72$, $m\angle C = 108$, $m\angle D = 144$; $m\angle A + m\angle D = 180$ (also, $m\angle B + m\angle C = 180$), so $\overline{AB} \parallel \overline{CD}$.

22. **a.** Let $m\angle R = x$, then $m\angle S = m\angle T = 3x$; $60 + 130 + x + 3x + 3x = (5 - 2)180$, $7x + 190 = 540$, $7x = 350$, $x = 50$; $m\angle R = 50$, $m\angle S = m\angle T = 150$
b. $m\angle Q + m\angle R = 180$, so $\overline{PQ} \parallel \overline{RS}$.

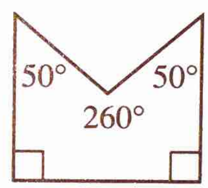
23. $\angle KBC$ and $\angle KCB$ are ext. $\triangle$ of a reg. decagon, so $m\angle KBC = m\angle KCB = \frac{360}{10} = 36$. $m\angle K = 180 - (m\angle KBC + m\angle KCB)$, so $m\angle K = 180 - (36 + 36) = 108$.

24. $\angle WBC$ and $\angle WCB$ are each ext. $\triangle$ of the n-gon, so $m\angle WBC = m\angle WCB = \frac{360}{n}$.
$m\angle W = 180 - (m\angle WBC + m\angle WCB) = 180 - 2\left(\frac{360}{n}\right) = \frac{180n - 720}{n}$

25. $2100 < (n - 2)180 < 2200$; $13\frac{2}{3} < n < 14\frac{2}{9}$; $n = 14$

C 26. **a.** $[(n + 1) - 2]180 = [(n - 2) + 1]180 = (n - 2)180 + 180 = S + 180$
b. $(2n - 2)180 = [2(n - 1)180] = 2[(n - 2) + 1]180 = 2[(n - 2)180 + 180] = 2(S + 180)$

27. **a.** Sketches may vary.
b. Yes; $90 + 90 + 50 + 260 + 50 = 540$



28. **a.** $\frac{(n - 2)180}{n} = x \cdot \frac{360}{n}$; $x = \frac{n - 2}{2}$
b. Even values ≥ 4

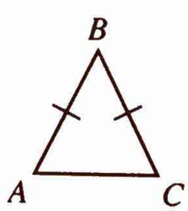
Page 107 • CLASSROOM EXERCISES

1. inductive **2.** inductive **3.** deductive **4.** inductive
5. deductive **6.** inductive

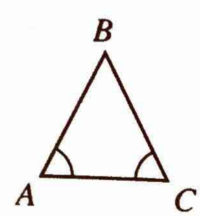
Pages 107–109 • WRITTEN EXERCISES

A **1.** 256, 1024 **2.** 6, 3 **3.** $\frac{1}{81}, \frac{1}{243}$ **4.** 25, 36 **5.** 17, 23 **6.** 40, 52 **7.** 15, 4
8. $-\frac{1}{4}, \frac{1}{8}$ **9.** 500, 250 **10.** Chan is older than Sarah. **11.** none
12. Polygon G has 7 sides. **13.** none **14.** No; deductively
15. $1234 \times 9 + 5 = 11111$ **16.** $9876 \times 9 + 4 = 88888$ **17.** $9999^2 = 99980001$

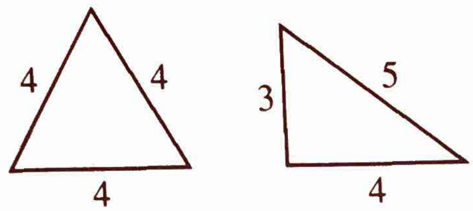
B **18.** True
Given: $\overline{BA} \cong \overline{BC}$
Prove: $\angle A \cong \angle C$



19. True
Given: $\angle A \cong \angle C$
Prove: $\overline{BA} \cong \overline{BC}$



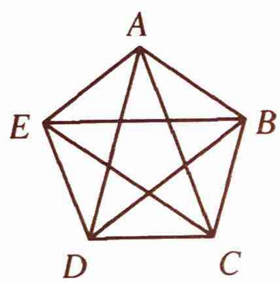
20. False



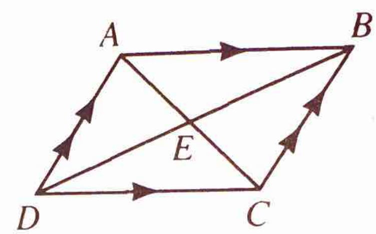
21. True

Given: $ABCDE$ is a reg. pentagon.

Prove: $\overline{AC} \cong \overline{AD} \cong \overline{BE} \cong \overline{BD} \cong \overline{CE}$



Ex. 21



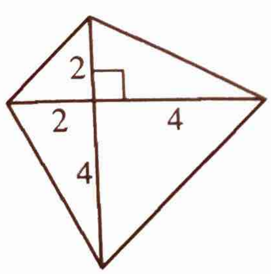
Ex. 22

22. True

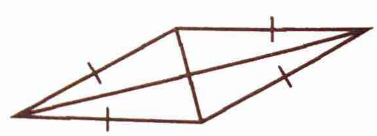
Given: $\overline{AB} \parallel \overline{DC}$; $\overline{AD} \parallel \overline{BC}$

Prove: $\overline{AE} \cong \overline{EC}$; $\overline{DE} \cong \overline{EB}$

23. False



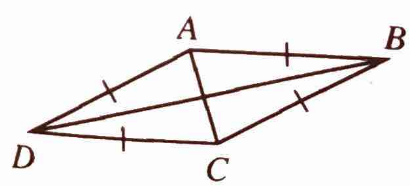
24. False



25. True

Given: $ABCD$ is equilateral.

Prove: $\overline{AC} \perp \overline{BD}$



26. a. 16 **b.** Guess: 32, Actual Count: 31

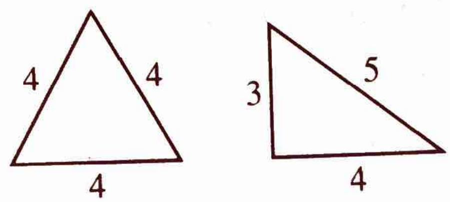
27. a. If both pairs of opp. sides of a quad. are $\parallel$, then opp. $\angle$s are $\cong$.

b. If both pairs of opp. $\angle$s of a quad. are $\cong$, then opp. sides are $\parallel$.

Given: $ABCD$ is a quad.; $m\angle A = m\angle C$; $m\angle B = m\angle D$

Prove: $\overline{AD} \parallel \overline{BC}$; $\overline{AB} \parallel \overline{CD}$

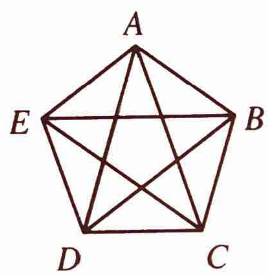
20. False



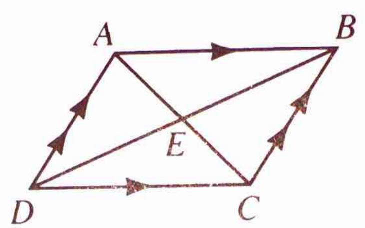
21. True

Given: $ABCDE$ is a reg. pentagon.

Prove: $\overline{AC} \cong \overline{AD} \cong \overline{BE} \cong \overline{BD} \cong \overline{CE}$



Ex. 21



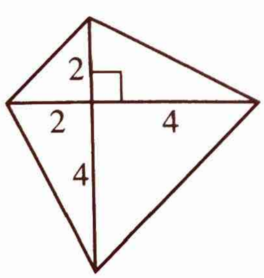
Ex. 22

22. True

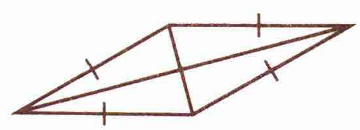
Given: $\overline{AB} \parallel \overline{DC}; \overline{AD} \parallel \overline{BC}$

Prove: $\overline{AE} \cong \overline{EC}; \overline{DE} \cong \overline{EB}$

23. False



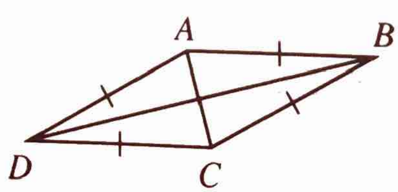
24. False



25. True

Given: $ABCD$ is equilateral.

Prove: $\overline{AC} \perp \overline{BD}$



26. **a.** 16 **b.** Guess: 32, Actual Count: 31

27. **a.** If both pairs of opp. sides of a quad. are $\parallel$, then opp. $\angle$s are $\cong$.

b. If both pairs of opp. $\angle$s of a quad. are $\cong$, then opp. sides are $\parallel$.

Given: $ABCD$ is a quad.; $m\angle A = m\angle C; m\angle B = m\angle D$

Prove: $\overline{AD} \parallel \overline{BC}; \overline{AB} \parallel \overline{CD}$

Statements	Reasons
1. $m\angle A + m\angle B + m\angle C + m\angle D = 360$	1. The sum of the meas. of the int. ∠s of a quad. is 360.
2. $m\angle A = m\angle C$; $m\angle B = m\angle D$	2. Given
3. $2m\angle A + 2m\angle B = 360$; $2m\angle C + 2m\angle B = 360$	3. Substitution Prop.
4. $m\angle A + m\angle B = 180$; $m\angle C + m\angle B = 180$	4. Div. Prop. of =
5. $\angle A$ and $\angle B$ are supp.; $\angle B$ and $\angle C$ are supp.	5. Def. of supp. ∠s
6. $\overline{AD} \parallel \overline{BC}$; $\overline{AB} \parallel \overline{CD}$	6. If 2 lines are cut by a trans. and s-s. int. ∠s are supp., then the lines are $\parallel$.

c. Both pairs of opp. ∠s of a quad. are ≅ if and only if opp. sides are $\parallel$.

C **28.** **a.** 13, 17, 23, 31, 41, 53, 67, 83, 101 **b.** Guess: a prime number **c.** 121, 143, neither of which is prime

29.

No. of sides	3	4	5	6	7	8	n
No. of diagonals	0	2	5	9	14	20	$\frac{n(n-3)}{2}$

30. **a.** There are 5 small △s each with one of the points A, B, C, D, E as one vertex. The other two ∠s of each of the △s are ext. ∠s of a pentagon. There are two complete sets of ext. ∠s of the pentagon, with each set having total meas. 360. Then $m\angle A + m\angle B + m\angle C + m\angle D + m\angle E + 360 + 360 = 5(180) = 900$ and $m\angle A + m\angle B + m\angle C + m\angle D + m\angle E = 180$. **b.** Using the same reasoning as in part (a), $m\angle A + m\angle B + m\angle C + m\angle D + m\angle E + m\angle F + 360 + 360 = 6(180) = 1080$ and $m\angle A + m\angle B + m\angle C + m\angle D + m\angle E + m\angle F = 360$. **c.** For each additional point of a star, the sum of the meas. of the ∠s increases by 180. The sum of the ∠ meas. for an n-pointed star is $180(n - 4)$. **d.** If a star has n points, $m\angle A + m\angle B + m\angle C + \cdots + m\angle N + 360 + 360 = n(180)$ and $m\angle A + m\angle B + m\angle C + \cdots + m\angle N = n(180) - 720 = 180(n - 4)$.

Page 109 • CALCULATOR KEY-IN

1. 1; 121; 12321; $1111 \times 1111 = 1234321$
2. 42; 4422; 444222; $6666 \times 6667 = 44442222$
3. 64; 9604; 996004; $9998 \times 9998 = 99960004$
4. 63; 7623; 776223; $7777 \times 9999 = 77762223$

Page 110 • SELF-TEST 2

1. acute **2.** scalene **3.** 60 **4.** 105, 35 **5.** $(2x + 4) + (3x - 9) = 90$; $x = 19$

6. $y = 50$; $110 = z + 50$, $z = 60$

7. $2x + 5 = 3x + 10$, $x = -5$ (reject); $2x + 5 = x + 12$, $x = 7$; $3x + 10 = x + 12$, $x = 1$

8. 8 **9.** equilateral, equiangular **10.** 360; $\frac{(10 - 2)180}{10} = 144$

11. $180 - 174 = 6$; $\frac{360}{6} = 60$ **12.** 32 **13.** 32 **14.** 36 **15.** 16

Pages 111–112 • CHAPTER REVIEW

1. 2 **2.** corr. **3.** alt. int. **4.** No; they can be skew. **5.** 105, 105

6. $70 = 6x - 2$; $x = 12$ **7.** $(8y - 40) + (2y + 20) = 180$; $y = 20$

8. $b \perp c$; if a trans. is $\perp$ to one of 2 $\parallel$ lines, then it is $\perp$ to the other one also.

9. $\overleftrightarrow{DE}$; $\angle A$ is supp. to $\angle ADE$, and if 2 lines are cut by a trans. and s-s. int. $\angle$s are supp., then the lines are $\parallel$.

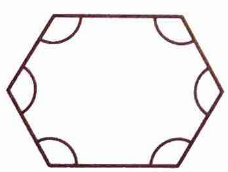
10. $\overleftrightarrow{BE} \parallel \overleftrightarrow{CF}$; both are $\perp$ to $\overleftrightarrow{DF}$.

11. corr. $\angle$s $\cong$; alt. int. $\angle$s $\cong$; s-s. int. $\angle$s supp.; in a plane, both lines are $\perp$ to a third line; both lines are $\parallel$ to a third line.

12. $x + (2x - 15) = 90$; $x = 35$ **13.** 180 **14.** 100

15. $\angle 3 \cong \angle 6$ (If 2 $\angle$s are supps. of $\cong$ $\angle$s, then the 2 $\angle$s are $\cong$.), $\angle 2 \cong \angle 8$ (If 2 $\angle$s of one $\triangle$ are $\cong$ to 2 $\angle$s of another $\triangle$, then the third $\angle$s are $\cong$.)

16. **a.**



b. $(6 - 2)180 = 720$

c. 360

17. $\frac{(18 - 2)180}{18} = 160$ **18.** $\frac{360}{24} = 15$ **19.** $\frac{(n - 2)180}{n} = 150$; $n = 12$

20. 75, 90 **21.** $\frac{1}{100}$, $-\frac{1}{1000}$

Pages 112–113 • CHAPTER TEST

1. sometimes **2.** sometimes **3.** never **4.** never **5.** never **6.** always

7. $(3x - 20) + x = 180$; $x = 50$ **8.** $2x + 12 = 4(x - 7)$; $x = 20$

9. $m\angle 1 = m\angle 2 = 60$, $m\angle 3 = 120$

10. $m\angle 1 = 58$, $m\angle 2 = 90$, $m\angle 3 = 32$, $m\angle 4 = 180 - (32 + 35) = 113$, $m\angle 5 = 35$, $m\angle 6 = 55$

11. $m\angle 4 = \frac{(5-2)180}{5} = 108$, $m\angle 5 = 108 - 72 = 36$, $m\angle 1 = 180 - 108 = 72$, $m\angle 2 = 180 - 108 = 72$, $m\angle 3 = 180 - (72 + 72) = 36$

12. $\angle EBC \cong \angle 2$ (If 2 lines are cut by a trans. and alt. int. ∠s are ≅, then the lines are ∥.), or $\angle 5 \cong \angle 3$ (If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.)

13.

Statements	Reasons
1. $\overrightarrow{BF}$ bisects $\angle ABE$; $\overrightarrow{DG}$ bisects $\angle CDB$.	1. Given
2. $m\angle GDB = \frac{1}{2}m\angle CDB$; $m\angle FBE = \frac{1}{2}m\angle ABE$	2. ∠ Bis. Thm.
3. $\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$	3. Given
4. $m\angle CDB = m\angle ABE$	4. If 2 ∥ lines are cut by a trans., then corr. ∠s are ≅.
5. $\frac{1}{2}m\angle CDB = \frac{1}{2}m\angle ABE$	5. Div. Prop. of =
6. $m\angle GDB = m\angle FBE$	6. Substitution Prop.
7. $\overleftrightarrow{BF} \parallel \overleftrightarrow{DG}$	7. If 2 lines are cut by a trans. and corr. ∠s are ≅, then the lines are ∥.

14. 15, 17

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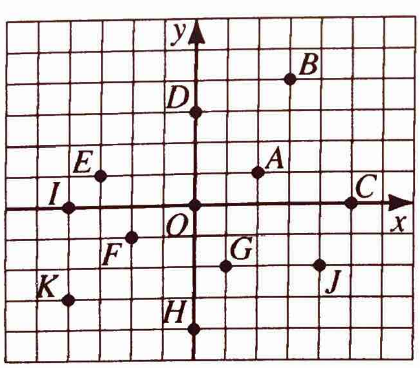
1. 3 **2.** 2 **3.** (0, 0) **4.** *Z* **5.** (3, 5) **6.** (4, 3) **7.** (4, 0) **8.** (0, 4)
9. (−5, 0) **10.** (−4, 3) **11.** (−2, 2) **12.** (−4, −2) **13.** (−2, −3)
14. (3, −2) **15.** *K*, *O*, *S* **16.** *O*, *R*, *Z* **17.** 3 **18.** c, e **19.** *M*, *N*, *P*
20. *T*, *U* **21.** *V*, *W* **22.** *J*, *Q*

23–34.



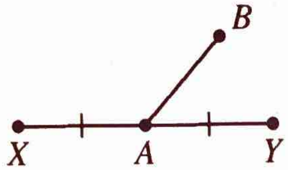
35. (2, 1) **36.** (2, 5) **37.** (0, 3) **38.** (−3, 0) **39.** (−4, −2) **40.** (1, −1)

Pages 114–115 • CUMULATIVE REVIEW: CHAPTERS 1–3

A **1.** sometimes **2.** always **3.** sometimes **4.** always **5.** always

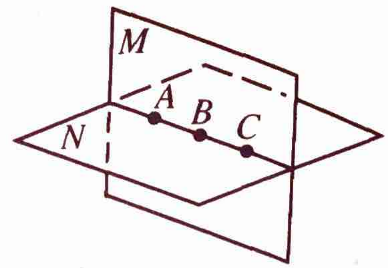
6–8. Sketches may vary.

6.



7.

8.



9. not possible **10.** $\frac{-3.5 + 8.5}{2} = \frac{5}{2}$ or 2.5

11. $5x + 13 = 9x - 39$, $x = 13$; $m\angle PQR = 2m\angle PQX = 2[5(13) + 13] = 156$

12. $180 - x = 2(90 - x) + 35$, $x = 35$; $\angle$ measure: 35, supp. measure: 145; comp. measure: 55

13. $x + 5x + 6x = 180$, $x = 15$; $\angle$ measures: 15, 75, 90 **14.** $2(60) = 120$ **15.** 90

16. $90 - 60 = 30$ **17.** 90 **18.** 60 **19.** $180 - 2(60) = 60$

20. $180 - 60 = 120$ **21.** $180 - 120 = 60$ **22.** $180 - 2(60) = 60$

23. False. If 2 lines are $\parallel$, then they do not intersect; true.

24. True. If 2 lines are $\perp$, then they intersect to form rt. $\angle$s; true.

25. True. If an $\angle$ is not obtuse, then it is acute; false.

26. True. If a $\triangle$ is isos., then it is equilateral; false.

27. Vert. $\angle$s are $\cong$. **28.** Seg. Add. Post. **29.** $\angle$ Add. Post.

30. If 2 lines are cut by a trans. and alt. int. $\angle$s are $\cong$, then the lines are $\parallel$.

31. The meas. of an ext. $\angle$ of a $\triangle$ = the sum of the meas. of the 2 remote int. $\angle$s.

32. Def. of $\perp$ lines **33.** The sum of the meas. of the $\angle$s of a $\triangle$ is 180.

34. Def. of $\perp$ lines **35.** X **36.** supp. **37.** $\frac{(n - 2)180}{n} = 108$, $n = 5$; pentagon

38. $2(12) = 24$ **39.** $\cong$ **40.** inductive **41.** biconditional **42.** 360

43. $(8 - 2)180 = 1080$ **44.** acute

B **45.**

Statements	Reasons
1. $\overline{WX} \perp \overline{XY}$	1. Given
2. $\angle 1$ is comp. to $\angle 2$.	2. If the ext. sides of 2 adj. acute $\angle$s are $\perp$, then the $\angle$s are comp.
3. $\angle 1$ is comp. to $\angle 3$.	3. Given
4. $\angle 2 \cong \angle 3$	4. If 2 $\angle$s are comps. of the same $\angle$, then the 2 $\angle$s are $\cong$.

46.

Statements	Reasons
1. $\overline{RU} \parallel \overline{ST}$	1. Given
2. $\angle 1 \cong \angle 2$	2. If 2 $\parallel$ lines are cut by a trans., then alt. int. $\angle$s are $\cong$.
3. $\angle R \cong \angle T$	3. Given
4. $\angle 3 \cong \angle 4$	4. If 2 $\angle$s of one $\triangle$ are $\cong$ to 2 $\angle$s of another $\triangle$, then the third $\angle$s are $\cong$.
5. $\overline{RS} \parallel \overline{UT}$	5. If 2 lines are cut by a trans. and alt. int. $\angle$s are $\cong$, then the lines are $\parallel$.