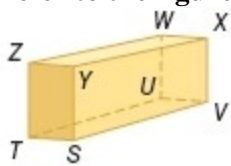


3-1 Parallel Lines and Transversals

Refer to the figure at the right to identify each of the following.



1. a plane parallel to plane ZWX

SOLUTION:

Parallel planes are planes that do not intersect. Plane TUV is the only plane parallel to plane ZWX .

ANSWER:

TUV

2. a segment skew to \overline{TS} that contains point W

SOLUTION:

Skew lines are lines that do not intersect. A segments that are skew to \overline{TS} and contains point W are \overline{WZ} , \overline{WU} .

ANSWER:

\overline{WZ} , \overline{WU}

3. all segments parallel to \overline{SV}

SOLUTION:

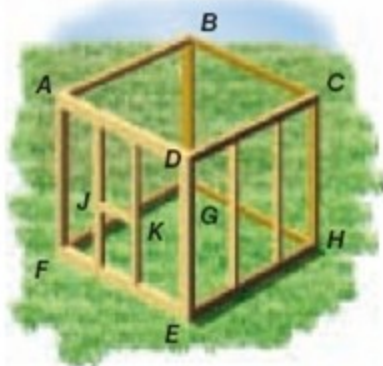
Parallel lines are coplanar lines that do not intersect. Ass segments parallel to \overline{SV} are \overline{YX} , \overline{TU} , \overline{ZW} .

ANSWER:

\overline{YX} , \overline{TU} , \overline{ZW}

3-1 Parallel Lines and Transversals

4. **CONSTRUCTION** Use the diagram of the partially framed storage shed shown to identify each of the following.
- Name three pairs of parallel planes.
 - Name three segments parallel to \overline{DE} .
 - Name two segments parallel to \overline{FE} .
 - Name two pairs of skew segments.



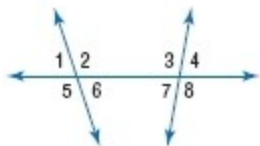
SOLUTION:

- Parallel planes are planes that do not intersect. The storage shed has the following pairs of parallel planes: plane $ABCD \parallel$ plane $FGHE$; plane $ADEF \parallel$ plane $BCHG$; plane $DCHE \parallel$ plane $ABGF$.
- Parallel lines are coplanar lines that do not intersect. Segments that are parallel to \overline{DE} are \overline{CH} , \overline{BG} , \overline{AF} .
- Parallel lines are coplanar lines that do not intersect. Segments that are parallel to \overline{FE} are \overline{AD} , \overline{GH} and \overline{BC} .
- Skew lines are lines that do not intersect. Two pairs of skewed lines are \overline{JK} and \overline{BG} ; \overline{JK} and \overline{CH} .

ANSWER:

- plane $ABCD \parallel$ plane $FGHE$; plane $ADEF \parallel$ plane $BCHG$; plane $DCHE \parallel$ plane $ABGF$
- \overline{CH} , \overline{BG} , \overline{AF}
- Sample answer: \overline{AD} and \overline{BC}
- Sample answer: \overline{JK} and \overline{BG} ; \overline{JK} and \overline{CH}

Classify the relationship between each pair of angles as alternate interior, alternate exterior, corresponding, or consecutive interior angles.



5. $\angle 1$ and $\angle 8$

SOLUTION:

Exterior angles that are non adjacent and lie on opposite sides of the transversal are alternate exterior angles.

ANSWER:

alternate exterior

3-1 Parallel Lines and Transversals

6. $\angle 2$ and $\angle 4$

SOLUTION:

Interior angles that lie on the same side of the transversal are corresponding angles.

ANSWER:

corresponding

7. $\angle 3$ and $\angle 6$

SOLUTION:

Interior angles that are non adjacent and lie on opposite sides of the transversal are alternate interior angles.

ANSWER:

alternate interior

8. $\angle 6$ and $\angle 7$

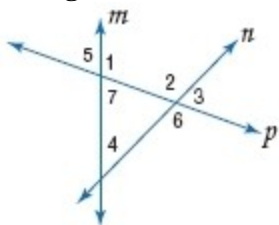
SOLUTION:

Interior angles that lie on the same side of the transversal are consecutive interior angles.

ANSWER:

consecutive interior

Identify the transversal connecting each pair of angles. Then classify the relationship between each pair of angles.



9. $\angle 2$ and $\angle 4$

SOLUTION:

A line that intersects two or more coplanar lines at two different points is called a transversal. The transversal connecting $\angle 2$ and $\angle 4$ is line n . Angles 2 and 4 are corresponding angles.

ANSWER:

line n ; corresponding

10. $\angle 5$ and $\angle 6$

SOLUTION:

A line that intersects two or more coplanar lines at two different points is called a transversal. The transversal connecting $\angle 5$ and $\angle 6$ is line p . Angles 5 and 6 are alternate exterior angles.

ANSWER:

line p ; alternate exterior

3-1 Parallel Lines and Transversals

11. $\angle 4$ and $\angle 7$

SOLUTION:

A line that intersects two or more coplanar lines at two different points is called a transversal.

The transversal connecting $\angle 4$ and $\angle 7$ is line m .

Angles 4 and 7 are consecutive interior angles.

ANSWER:

line m ; consecutive interior

12. $\angle 2$ and $\angle 7$

SOLUTION:

A line that intersects two or more coplanar lines at two different points is called a transversal.

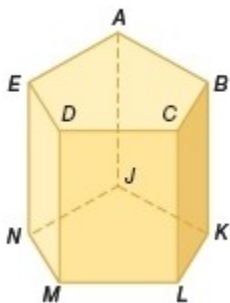
The transversal connecting $\angle 2$ and $\angle 7$ is line p .

Angles 2 and 7 are alternate interior angles.

ANSWER:

line p ; alternate interior

Refer to the figure to identify each of the following.



13. all segments parallel to \overline{DM}

SOLUTION:

Parallel segments are coplanar segments that do not intersect. Segments that are parallel to \overline{DM} are \overline{CL} , \overline{EN} , \overline{BK} , \overline{AJ} .

ANSWER:

\overline{CL} , \overline{EN} , \overline{BK} , \overline{AJ}

14. a plane parallel to plane ACD

SOLUTION:

Parallel planes are planes that do not intersect. A plane parallel to Plane ACD is Plane JLM .

ANSWER:

JLM

3-1 Parallel Lines and Transversals

15. a segment skew to \overline{BC}

SOLUTION:

Skew lines are lines that do not intersect and are not coplanar. Segment skew to \overline{BC} are \overline{EN} , \overline{AJ} , \overline{DM} , \overline{NM} , \overline{NJ} , \overline{JK} or \overline{ML} .

ANSWER:

\overline{EN} , \overline{AJ} , \overline{DM} , \overline{NM} , \overline{NJ} , \overline{JK} or \overline{ML}

16. all planes intersecting plane EDM

SOLUTION:

All planes intersecting Plane EDM are Plane DCL , Plane NML , Plane AED , and Plane AEN .

ANSWER:

DCL , NML , AED , AEN

17. all segments skew to \overline{AE}

SOLUTION:

Skew lines are lines that do not intersect and are not coplanar. All segments skew to \overline{AE} are \overline{KL} , \overline{CL} , \overline{BK} , \overline{ML} , \overline{DM} , \overline{NM} , \overline{KJ} .

ANSWER:

\overline{KL} , \overline{CL} , \overline{BK} , \overline{ML} , \overline{DM} , \overline{NM} , \overline{KJ}

18. a segment parallel to \overline{EN}

SOLUTION:

Parallel segments are coplanar segments that do not intersect. Segments parallel to \overline{EN} are \overline{AJ} , \overline{BK} , \overline{CL} , or \overline{DM} .

ANSWER:

\overline{AJ} , \overline{BK} , \overline{CL} , or \overline{DM}

19. a segment parallel to \overline{AB} through point J

SOLUTION:

Parallel segments are coplanar segment that do not intersect. A segment parallel to \overline{AB} through point J is \overline{JK} .

ANSWER:

\overline{JK}

3-1 Parallel Lines and Transversals

20. a segment skew to \overline{CL} through point E

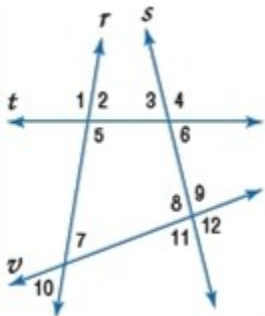
SOLUTION:

Skew segments are segments that do not intersect and are not coplanar. A segments skew to \overline{CL} through point E are $\overline{AE}, \overline{ED}$.

ANSWER:

$\overline{AE}, \overline{ED}$

CCSS PRECISION Identify the transversal connecting each pair of angles. Then classify the relationship between each pair of angles as *alternate interior*, *alternate exterior*, *corresponding*, or *consecutive interior angles*.



21. $\angle 4$ and $\angle 9$

SOLUTION:

The transversal connecting $\angle 4$ and $\angle 9$ is line s . One interior ($\angle 9$) and one exterior ($\angle 4$) (non adjacent) angles that lie on the same side of the transversal are corresponding angles.

ANSWER:

line s ; corresponding

22. $\angle 5$ and $\angle 7$

SOLUTION:

The transversal connecting $\angle 5$ and $\angle 7$ is line r . Interior angles that lie on the same side of the transversal are consecutive interior angles.

ANSWER:

line r ; consecutive interior

23. $\angle 3$ and $\angle 5$

SOLUTION:

The transversal connecting $\angle 3$ and $\angle 5$ is line t . Interior angles that are non adjacent and lie on opposite sides of the transversal are alternate interior angles.

ANSWER:

line t ; alternate interior

3-1 Parallel Lines and Transversals

24. $\angle 10$ and $\angle 11$

SOLUTION:

The transversal connecting $\angle 10$ and $\angle 11$ is line v . One interior ($\angle 11$) and one exterior ($\angle 10$) (non adjacent) angles that lie on the same side of the transversal are corresponding angles.

ANSWER:

line v ; corresponding

25. $\angle 1$ and $\angle 6$

SOLUTION:

The transversal connecting $\angle 1$ and $\angle 6$ is line t . Exterior angles that are non adjacent and lie on opposite sides of the transversal are alternate exterior angles.

ANSWER:

line t ; alternate exterior

26. $\angle 6$ and $\angle 8$

SOLUTION:

The transversal connecting $\angle 6$ and $\angle 8$ is line s . Interior angles that lie on the same side of the transversal are consecutive interior angles.

ANSWER:

line s ; alternate interior

27. $\angle 2$ and $\angle 3$

SOLUTION:

The transversal connecting $\angle 2$ and $\angle 3$ is line t . Interior angles that lie on the same side of the transversal are consecutive interior angles.

ANSWER:

line t ; consecutive interior

28. $\angle 9$ and $\angle 10$

SOLUTION:

The transversal connecting $\angle 9$ and $\angle 10$ is line v . Exterior angles that are non adjacent and lie on opposite sides of the transversal are alternate exterior angles.

ANSWER:

line v ; alternate exterior

29. $\angle 4$ and $\angle 11$

SOLUTION:

The transversal connecting $\angle 4$ and $\angle 11$ is line s . Exterior angles that are non adjacent and lie on opposite sides of the transversal are alternate exterior angles.

ANSWER:

line s ; alternate exterior

3-1 Parallel Lines and Transversals

30. $\angle 7$ and $\angle 11$

SOLUTION:

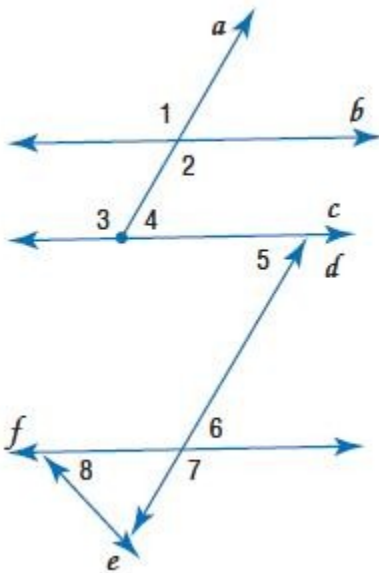
The transversal connecting $\angle 7$ and $\angle 11$ is line v . Interior angles that are non adjacent and lie on opposite sides of the transversal are alternate interior angles.

ANSWER:

line v ; alternate interior

SAFETY Identify the transversal connecting each pair of angles in the photo of a fire escape shown. Then classify the relationship between each pair of angles.

Refer to Page 176.



31. $\angle 1$ and $\angle 2$

SOLUTION:

Angles 1 and 2 are formed by line a crossing lines b and c . So, the transversal connecting $\angle 1$ and $\angle 2$ is line a . Since $\angle 1$ and $\angle 2$ are formed at the same intersection, the angles are two nonadjacent angles formed by two intersecting lines. Therefore, $\angle 1$ and $\angle 2$ are vertical angles.

ANSWER:

line a ; vertical

32. $\angle 2$ and $\angle 4$

SOLUTION:

The transversal connecting $\angle 2$ and $\angle 4$ is line a . Interior angles that lie on the same side of the transversal are consecutive interior angles.

ANSWER:

line a ; consecutive interior

3-1 Parallel Lines and Transversals

33. $\angle 4$ and $\angle 5$

SOLUTION:

The transversal connecting $\angle 4$ and $\angle 5$ is line c . Interior angles that are non adjacent and lie on opposite sides of the transversal are alternate interior angles.

ANSWER:

line c ; alternate interior

34. $\angle 6$ and $\angle 7$

SOLUTION:

Angles 6 and 7 are formed by line d crossing lines f and e or by line f crossing lines e and d . So, the transversal connecting $\angle 6$ and $\angle 7$ is either line d or line f . The angles are at the same point of intersection, and are adjacent angles with non common sides that are opposite rays. Therefore, $\angle 6$ and $\angle 7$ are a linear pair.

ANSWER:

line d or line f ; linear pair

35. $\angle 7$ and $\angle 8$

SOLUTION:

The transversal connecting $\angle 7$ and $\angle 8$ is line f . corresponding One interior ($\angle 8$) and one exterior ($\angle 7$) (non adjacent) angles that lie on the same side of the transversal are corresponding angles.

ANSWER:

line f ; corresponding

36. $\angle 2$ and $\angle 3$

SOLUTION:

The transversal connecting $\angle 2$ and $\angle 3$ is line a . Interior angles that are non adjacent and lie on opposite sides of the transversal are alternate interior angles.

ANSWER:

line a ; alternate interior

3-1 Parallel Lines and Transversals

37. **POWER** Power lines are not allowed to intersect.

a. What must be the relationship between power lines p and m ? Explain your reasoning.

b. What is the relationship between line q and lines p and m ?

Refer to Page 176.



SOLUTION:

a. Sample answer: Since the lines are coplanar and they cannot touch, they are parallel. Parallel lines are coplanar lines that do not intersect.

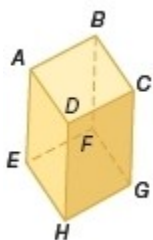
b. Line q is a transversal of lines p and m . A transversal is a line that intersects two or more coplanar lines at different points.

ANSWER:

a. Sample answer: Since the lines are coplanar and they cannot touch, they are parallel.

b. Line q is a transversal of lines p and m .

Describe the relationship between each pair of segments as parallel, skew, or intersecting.



38. \overline{FG} and \overline{BC}

SOLUTION:

\overline{FG} and \overline{BC} are coplanar lines that do not intersect. Therefore, they are parallel lines.

ANSWER:

parallel

39. \overline{AB} and \overline{CG}

SOLUTION:

\overline{AB} and \overline{CG} are lines that do not intersect and are not coplanar. Therefore, they are skew lines.

ANSWER:

skew

3-1 Parallel Lines and Transversals

40. \overline{DH} and \overline{HG}

SOLUTION:

\overline{DH} and \overline{HG} are lines that intersect. Therefore they are intersecting lines.

ANSWER:

intersecting

41. \overline{DH} and \overline{BF}

SOLUTION:

\overline{DH} and \overline{BF} are coplanar lines that do not intersect.. Therefore, they are parallel lines.

ANSWER:

parallel

42. \overline{EF} and \overline{BC}

SOLUTION:

\overline{EF} and \overline{BC} are lines that do not intersect and are not coplanar. Therefore, they are skew lines.

ANSWER:

skew

43. \overline{CD} and \overline{AD}

SOLUTION:

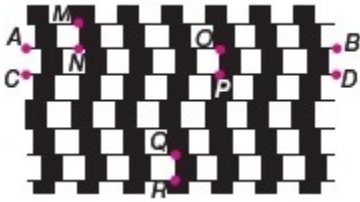
\overline{CD} and \overline{AD} are line that intersect. Therefore they are intersecting lines.

ANSWER:

intersecting

3-1 Parallel Lines and Transversals

44. **CCSS SENSE-MAKING** The illusion shown is created using squares and straight lines.
- How are \overline{AB} and \overline{CD} related? Justify your reasoning.
 - How are \overline{MN} and \overline{QR} related? \overline{AB} , \overline{CD} , and \overline{OP} ?



SOLUTION:

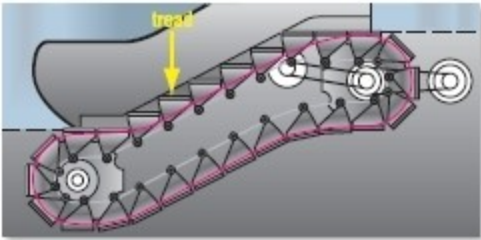
- The distance between the segments is the same anywhere on the segment. The segments also are joined by sides of the squares. Since the consecutive sides of a square are perpendicular, the segments are perpendicular to the same line. Lines that are perpendicular to the same line are parallel. Therefore, $\overline{AB} \parallel \overline{CD}$.
- Each pair of consecutive segments going from left to right is joined by the side of square. Since the sides of the square are perpendicular, each pair of consecutive segments is parallel. Lines that are parallel to the same line are parallel, so all the segments going from left to right are parallel. Therefore, $\overline{MN} \parallel \overline{QR}$.
Since \overline{OP} crosses \overline{AB} and \overline{CD} at points O and P , \overline{OP} is a transversal between \overline{AB} and \overline{CD} .

ANSWER:

- $\overline{AB} \parallel \overline{CD}$; The distance between the segments is the same anywhere on the segment.
- $\overline{MN} \parallel \overline{QR}$; \overline{OP} is a transversal between \overline{AB} and \overline{CD} .

3-1 Parallel Lines and Transversals

45. **ESCALATORS** Escalators consist of steps on a continuous loop that is driven by a motor. At the top and bottom of the platform, the steps collapse to provide a level surface for entrance and exit.



- What is the relationship between the treads of the ascending stairs?
- What is the relationship between the treads of the two steps at the top of the incline?
- How do the treads of the steps on the incline of the escalator relate to the treads of the steps on the bottom of the escalator?

SOLUTION:

- The treads of the ascending steps represent line segments on the edge of each step. The lines containing each of the segments do not intersect. Therefore, the treads are parallel. If all the ascending steps had the same height between them, the treads would also be coplanar. However, the steps at the top and bottom of the escalator are collapsing, so it is likely that the height between the first and last pairs of steps will be different than the height between the others.
- The two steps at the top of the escalator collapse to form a level surface. The lines containing the segments represented by the treads are both in the same plane, so the treads are coplanar. These lines also do not intersect, so they would be parallel.
- Each tread of the steps on the incline of the escalator is parallel to each of the two treads of the steps on the bottom of the escalator. The two treads of the steps on the bottom are in the same plane. The lines containing the segments represented by the three treads cannot be in the same plane. Therefore, the treads of the steps on the incline and the treads of the steps on the bottom are skew.

ANSWER:

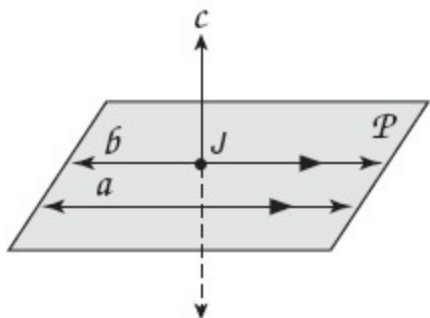
- parallel
- coplanar
- skew

3-1 Parallel Lines and Transversals

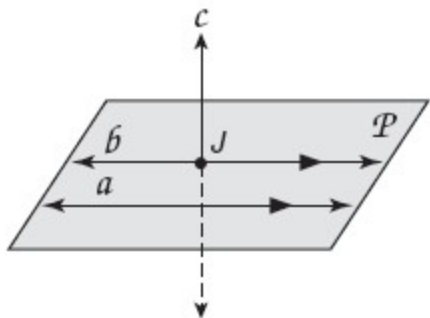
46. **OPEN ENDED** Plane P contains lines a and b . Line c intersects plane P at point J . Lines a and b are parallel, lines a and c are skew, and lines b and c are not skew. Draw a figure based upon this description.

SOLUTION:

Draw a plane with two lines (a & b) that are parallel. Since lines b and c are not skew, draw line c intersects plane P at point J which is on line b .



ANSWER:

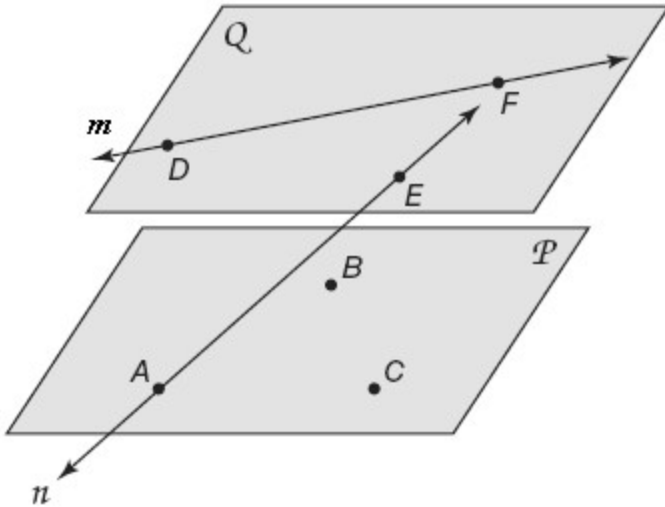


3-1 Parallel Lines and Transversals

47. **CHALLENGE** Suppose points A , B , and C lie in plane P , and points D , E , and F lie in plane Q . Line m contains points D and F and does not intersect plane P . Line n contains points A and E .
- Draw a diagram to represent the situation.
 - What is the relationship between planes P and Q ?
 - What is the relationship between lines m and n ?

SOLUTION:

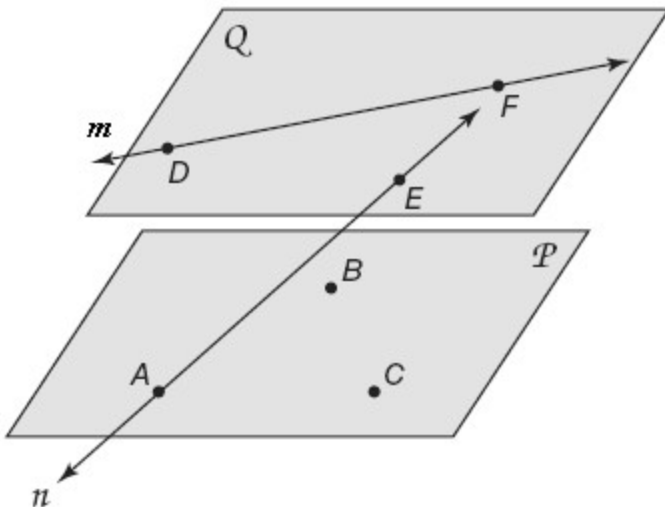
a. Draw two plane with points A , B , and C on plane P and points D , E , and F on plane Q . On plane Q , draw line m through points D and F that does not intersect plane P . Then draw a line n through points A and E .



- The planes must be parallel so that line m does not intersect plane P .
- Lines m and n are not coplanar and will never intersect and are therefore skew lines.

ANSWER:

a.



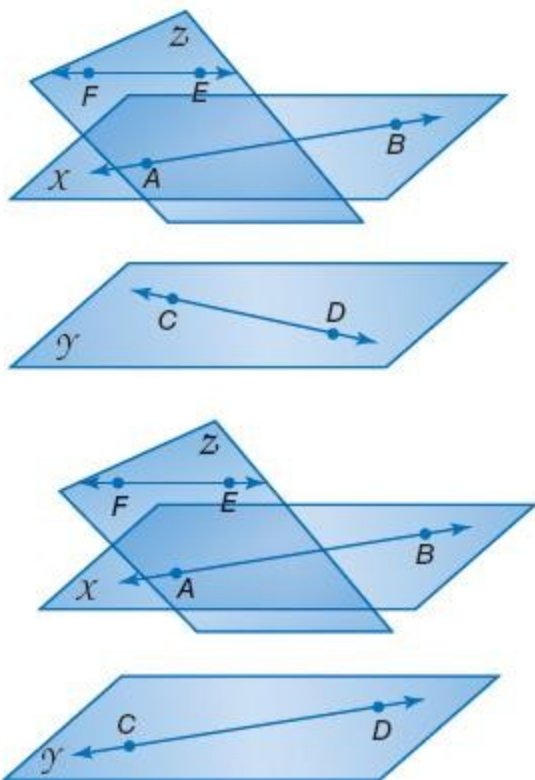
- parallel
- skew

3-1 Parallel Lines and Transversals

REASONING Plane X and plane Y are parallel and plane Z intersects plane X . Line \overline{AB} is in plane X , line \overline{CD} is in plane Y , and line \overline{EF} is in plane Z . Determine whether each statement is *always*, *sometimes*, or *never* true. Explain.

48. \overline{AB} is skew to \overline{CD} .

SOLUTION:



\overline{AB} is sometimes skew to \overline{CD} . \overline{AB} is either skew or parallel to \overline{CD} because the lines will never intersect and are not coplanar.

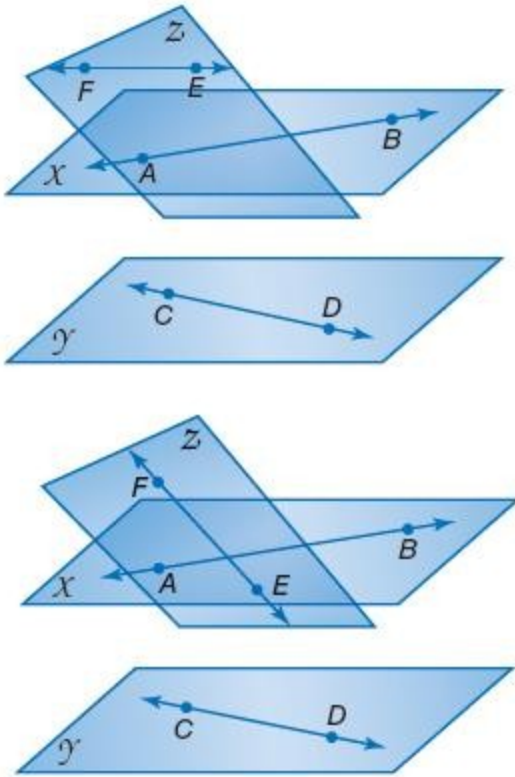
ANSWER:

Sometimes; \overline{AB} is either skew or parallel to \overline{CD} because the lines will never intersect and are not coplanar.

3-1 Parallel Lines and Transversals

49. \overleftrightarrow{AB} intersects \overleftrightarrow{EF} .

SOLUTION:



\overleftrightarrow{AB} sometimes intersects \overleftrightarrow{EF} . \overleftrightarrow{AB} intersects \overleftrightarrow{EF} depending on where the planes intersect.

ANSWER:

Sometimes; \overleftrightarrow{AB} intersects \overleftrightarrow{EF} depending on where the planes intersect.

50. **WRITING IN MATH** Can a pair of planes be described as skew?

SOLUTION:

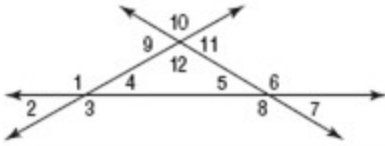
No; sample answer: From the definition of skew lines, the lines must not intersect and cannot be coplanar. Different planes cannot be coplanar, but they are always parallel or intersecting. Therefore, skew lines must be on planes that are parallel or intersecting.

ANSWER:

No; sample answer: From the definition of skew lines, the lines must not intersect and cannot be coplanar. Different planes cannot be coplanar, but they are always parallel or intersecting. Therefore, skew lines must be on planes that are parallel or intersecting.

3-1 Parallel Lines and Transversals

51. Which of the following angle pairs are alternate exterior angles?



- A $\angle 1$ and $\angle 5$
- B $\angle 2$ and $\angle 6$
- C $\angle 2$ and $\angle 10$
- D $\angle 5$ and $\angle 9$

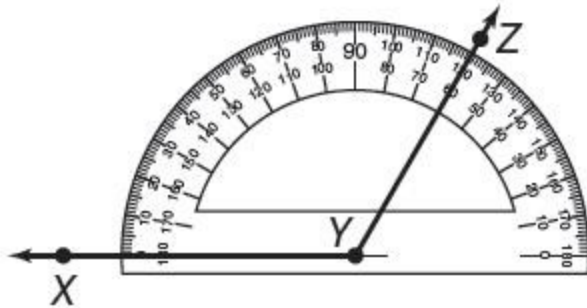
SOLUTION:

Alternate exterior angles are nonadjacent exterior angles that lie on opposite sides of a transversal. In the figure, angles 2 and 6 are alternate exterior angles. So, the correct choice is B.

ANSWER:

B

52. What is the measure of $\angle XYZ$?



- F 30°
- G 60°
- H 120°
- J 150°

SOLUTION:

\overrightarrow{YX} passes through 0 on the outermost scale. \overrightarrow{YZ} passes through 120 on the outermost scale. The measure of $\angle XYZ$ is 120° .

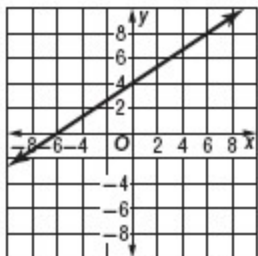
Therefore, the correct choice is H.

ANSWER:

H

3-1 Parallel Lines and Transversals

53. **SHORT RESPONSE** Name the coordinates of the points representing the x - and y -intercepts of the graph shown below.



SOLUTION:

To find the x -intercept, find the x -coordinate of the point on the line where $y = 0$. The x -intercept is -6 . To find the y -intercept, find the y -coordinate of the point on the line where $x = 0$. The y -intercept is 4 .

ANSWER:

$(0, 4), (-6, 0)$

54. **SAT/ACT** Of the following, the one that is *not* equivalent to 485 is:

A $(3 \times 100) + (4 \times 10) + 145$

B $(3 \times 100) + (18 \times 10) + 5$

C $(4 \times 100) + (8 \times 10) + 15$

D $(4 \times 100) + (6 \times 10) + 25$

E $(4 \times 100) + (5 \times 10) + 35$

SOLUTION:

Test option A.

$$(3 \times 100) + (4 \times 10) + 145 = 300 + 40 + 145 = 485$$

So, this option is incorrect.

Test option B.

$$(3 \times 100) + (18 \times 10) + 5 = 300 + 180 + 5 = 485$$

Test option C.

$$(4 \times 100) + (8 \times 10) + 15 = 400 + 80 + 15 = 495$$

So, the correct choice is C.

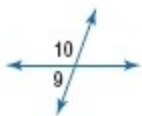
ANSWER:

C

3-1 Parallel Lines and Transversals

Find the measure of each numbered angle.

55. $m\angle 9 = 2x - 4$,
 $m\angle 10 = 2x + 4$



SOLUTION:

In the figure, $m\angle 9 + m\angle 10 = 180$.

$$m\angle 9 + m\angle 10 = 180 \quad \text{Definition of Linear Pair}$$

$$2x - 4 + 2x + 4 = 180 \quad \text{Substitution.}$$

$$4x = 180 \quad \text{Simplify.}$$

$$\frac{4x}{4} = \frac{180}{4} \quad \text{Divide each side by 4.}$$

$$x = 45 \quad \text{Simplify.}$$

Substitute $x = 45$ in $m\angle 9 = 2x - 4$.

$$m\angle 9 = 2x - 4$$

$$= 2(45) - 4 \quad \text{Substitution}$$

$$= 86$$

Substitute $x = 45$ in $m\angle 10 = 2x + 4$.

$$m\angle 10 = 2x + 4$$

$$= 2(45) + 4 \quad \text{Substitution.}$$

$$= 94$$

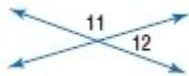
ANSWER:

$$m\angle 9 = 86,$$

$$m\angle 10 = 94$$

3-1 Parallel Lines and Transversals

56. $m\angle 11 = 4x$,
 $m\angle 12 = 2x - 6$



SOLUTION:

In the figure, $m\angle 11 + m\angle 12 = 180$.

$$m\angle 11 + m\angle 12 = 180 \quad \text{Definition of Linear Pair}$$

$$4x + 2x - 6 = 180 \quad \text{Substitution.}$$

$$6x - 6 + 6 = 180 + 6 \quad \text{Add 6 to each side.}$$

$$6x = 186 \quad \text{Simplify.}$$

$$\frac{6x}{6} = \frac{186}{6} \quad \text{Divide each side by 6.}$$

$$x = 31 \quad \text{Simplify.}$$

Substitute $x = 31$ in $m\angle 11 = 4x$.

$$m\angle 11 = 4x$$

$$= 4(31) \quad \text{Substitution.}$$

$$= 124$$

Substitute $x = 31$ in $m\angle 12 = 2x - 6$.

$$m\angle 12 = 2x - 6$$

$$= 2(31) - 6 \quad \text{Substitution.}$$

$$= 56$$

ANSWER:

$$m\angle 11 = 124,$$

$$m\angle 12 = 56$$

3-1 Parallel Lines and Transversals

57. $m\angle 19 = 100 + 20x$,
 $m\angle 20 = 20x$



SOLUTION:

In the figure, $m\angle 19 + m\angle 20 = 180$.

$$m\angle 19 + m\angle 20 = 180 \quad \text{Definition of Linear Pair}$$

$$100 + 20x + 20x = 180 \quad \text{Substitution.}$$

$$100 + 40x = 180 \quad \text{Simplify.}$$

$$100 - 100 + 40x = 180 - 100 \quad \text{Subtract 100 from each side.}$$

$$40x = 80 \quad \text{Simplify.}$$

$$\frac{40x}{40} = \frac{80}{40} \quad \text{Divide each side by 40.}$$

$$x = 2 \quad \text{Simplify.}$$

Substitute $x = 2$ in $m\angle 19 = 100 + 20x$.

$$m\angle 19 = 100 + 20x$$

$$= 100 + 20(2) \quad \text{Substitution.}$$

$$= 140$$

Substitute $x = 2$ in $m\angle 20 = 20x$.

$$m\angle 20 = 20(2)$$

$$m\angle 20 = 20(2) \quad \text{Substitution.}$$

$$= 40$$

ANSWER:

$$m\angle 19 = 140,$$

$$m\angle 20 = 40$$

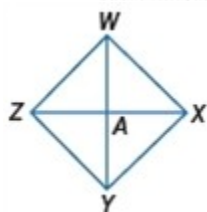
58. **PROOF** Prove the following.

Given: $\overline{WY} \cong \overline{ZX}$

A is the midpoint of \overline{WY} .

A is the midpoint of \overline{ZX} .

Prove: $\overline{WA} \cong \overline{ZA}$



SOLUTION:

Given: $\overline{WY} \cong \overline{ZX}$

3-1 Parallel Lines and Transversals

A is the midpoint of \overline{WY} .

A is the midpoint of \overline{ZX} .

Prove: $\overline{WA} \cong \overline{ZA}$

Proof:

Statements (Reasons)

1. $\overline{WY} \cong \overline{ZX}$

A is the midpoint of \overline{WY} .

A is the midpoint of \overline{ZX} . (Given)

2. $WY = ZX$ (Def. of \cong segments)

3. $WA = AY$, $ZA = AX$ (Def. of midpoint)

4. $WY = WA + AY$, $ZX = ZA + AX$ (Seg. Add. Post.)

5. $WA + AY = ZA + AX$ (Substitution)

6. $WA + WA = ZA + ZA$ (Substitution)

7. $2WA = 2ZA$ (Substitution)

8. $WA = ZA$ (Division Property)

9. $\overline{WA} \cong \overline{ZA}$ (Def. of \cong segments.)

ANSWER:

Given: $\overline{WY} \cong \overline{ZX}$

A is the midpoint of \overline{WY} .

A is the midpoint of \overline{ZX} .

Prove: $\overline{WA} \cong \overline{ZA}$

Proof:

Statements (Reasons)

1. $\overline{WY} \cong \overline{ZX}$

A is the midpoint of \overline{WY} .

A is the midpoint of \overline{ZX} . (Given)

2. $WY = ZX$ (Def. of \cong segments)

3. $WA = AY$, $ZA = AX$ (Def. of midpoint)

4. $WY = WA + AY$, $ZX = ZA + AX$ (Seg. Add. Post.)

5. $WA + AY = ZA + AX$ (Substitution)

6. $WA + WA = ZA + ZA$ (Substitution)

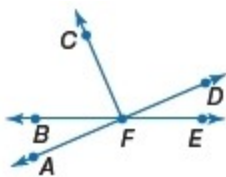
7. $2WA = 2ZA$ (Substitution)

8. $WA = ZA$ (Division Property)

9. $\overline{WA} \cong \overline{ZA}$ (Def. of \cong segments.)

3-1 Parallel Lines and Transversals

ALGEBRA Use the figure.



59. If $m\angle CFD = 12a + 45$, find a so that $\overline{FC} \perp \overline{FD}$.

SOLUTION:

$$\begin{aligned}m\angle CFD &= 12a + 45 && \text{Given} \\90 &= 12a + 45 && \text{Definition of perpendicular lines.} \\90 - 45 &= 12a + 45 - 45 && \text{Subtract 45 from each side.} \\45 &= 12a && \text{Simplify.} \\\frac{45}{12} &= \frac{12a}{12} && \text{Divide each side by 12.} \\a &= 3.75 && \text{Simplify.}\end{aligned}$$

ANSWER:

3.75

60. If $m\angle AFB = 8x - 6$ and $m\angle BFC = 14x + 8$, find the value of x so that $\angle AFC$ is a right angle.

SOLUTION:

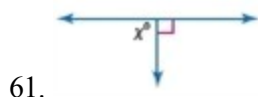
$$\begin{aligned}m\angle AFC &= m\angle AFB + m\angle BFC && \text{Definition of right angles.} \\90 &= 8x - 6 + 14x + 8 && \text{Substitution.} \\90 &= 22x + 2 && \text{Simplify.} \\90 - 2 &= 22x + 2 + 2 && \text{Subtract 2 from each side.} \\88 &= 22x && \text{Simplify.} \\\frac{88}{22} &= \frac{22x}{22} && \text{Divide each side by 22.} \\4 &= x && \text{Simplify.} \\x &= 4\end{aligned}$$

ANSWER:

4

3-1 Parallel Lines and Transversals

Find x .



SOLUTION:

In the figure, $x + 90 = 180$.

$$x + 90 = 180 \quad \text{Original equation}$$

$$x + 90 - 90 = 180 - 90 \quad \text{Subtract 90 from each side.}$$

$$x = 90 \quad \text{Simplify.}$$

ANSWER:

90



SOLUTION:

In the figure, $x + 78 = 180$.

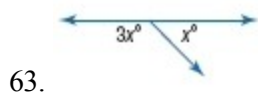
$$x + 78 = 180 \quad \text{Original equation}$$

$$x + 78 - 78 = 180 - 78 \quad \text{Subtract 78 from each side.}$$

$$x = 102 \quad \text{Simplify.}$$

ANSWER:

102



SOLUTION:

In the figure, $x + 3x = 180$.

$$x + 3x = 180 \quad \text{Original equation}$$

$$4x = 180 \quad \text{Simplify.}$$

$$\frac{4x}{4} = \frac{180}{4} \quad \text{Divide each side by 4.}$$

$$x = 45 \quad \text{Simplify.}$$

ANSWER:

45