

# Geometry · Parallel Lines, Transversals and Proofs · Worksheet Answer Key

Common Core G-CO.C.9 · mathovore.fr

This answer key gives a full worked solution for every problem on the parallel lines and transversals worksheet. Check each reason against the theorem you cited, and compare your algebra step by step.

## GeometryCommon Core: G-CO.C.9

### Problem 1: Name the angle pairs

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- a.  $\angle 4$  and  $\angle 5$  lie between the lines on opposite sides of the transversal: **alternate interior angles**.
- b.  $\angle 2$  and  $\angle 6$  are in the same position at the two intersections: **corresponding angles**.
- c.  $\angle 1$  and  $\angle 8$  lie outside the lines on opposite sides of the transversal: **alternate exterior angles**.
- d.  $\angle 3$  and  $\angle 5$  lie between the lines on the same side of the transversal: **same-side interior angles**.

### Problem 2: Corresponding angles

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$\angle 1$  and  $\angle 5$  are corresponding angles. By the Corresponding Angles Theorem they are equal.  
 $m\angle 5 = 118^\circ$ .

### Problem 3: Alternate interior angles

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$\angle 3$  and  $\angle 6$  are alternate interior angles, so they are equal.  
 $m\angle 6 = 72^\circ$ .

### Problem 4: Same-side interior angles

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$\angle 3$  and  $\angle 5$  are same-side interior angles, so they are supplementary.  
 $180 - 53 = 127$ .  $m\angle 5 = 127^\circ$ .

### Problem 5: Alternate exterior angles

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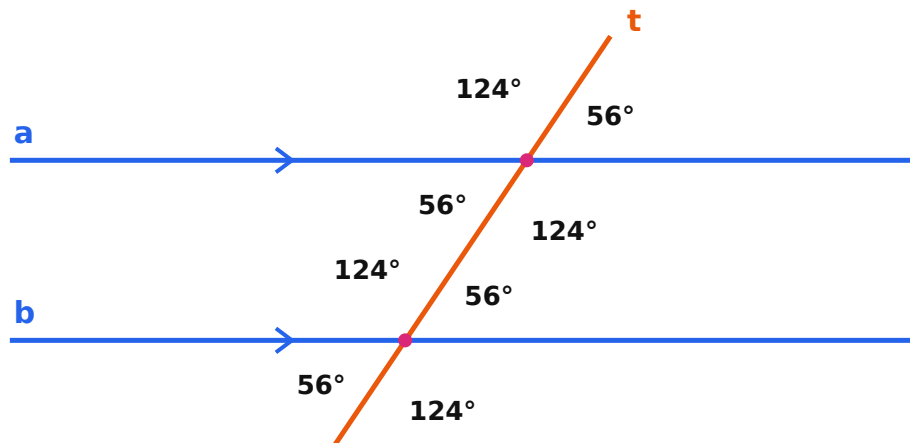
$\angle 2$  and  $\angle 7$  are alternate exterior angles. For parallel lines they are equal.

$$m\angle 7 = 109^\circ.$$

### Problem 6: Find all eight angles

Vertical angles are equal:  $m\angle 4 = 124^\circ$ . Corresponding angles are equal:  $m\angle 5 = m\angle 8 = 124^\circ$ . Each other angle forms a linear pair with a  $124^\circ$  angle:  $180 - 124 = 56$ .

$$m\angle 1 = m\angle 4 = m\angle 5 = m\angle 8 = 124^\circ; m\angle 2 = m\angle 3 = m\angle 6 = m\angle 7 = 56^\circ.$$



All eight measures.

### Problem 7: Corresponding angles with algebra

Corresponding angles are equal:  $3x + 15 = 5x - 25$ .

Subtract  $3x$  and add 25:  $40 = 2x$ , so  $x = 20$ .

$3(20) + 15 = 75$  and  $5(20) - 25 = 75$ . Each angle measures  $75^\circ$ .

### Problem 8: Alternate interior with algebra

$\angle 4$  and  $\angle 5$  are alternate interior angles, so  $4x - 12 = 2x + 30$ .

Subtract  $2x$ , add 12:  $2x = 42$ , so  $x = 21$ .

$m\angle 4 = 4(21) - 12 = 72$ , so  $m\angle 4 = 72^\circ$ . Check:  $2(21) + 30 = 72$ .

### Problem 9: Same-side interior with algebra

Same-side interior angles are supplementary:  $(2x + 20) + (3x - 10) = 180$ .

Combine:  $5x+10=180$ , so  $5x=170$  and  $x=34$ .

$2(34)+20=88$  and  $3(34)-10=92$ . The angles are  $88^\circ$  and  $92^\circ$ ;  $88+92=180$ .

### **Problem 10: Same-side exterior with algebra**

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Same-side exterior angles between parallel lines are supplementary:  $(4x+8)+(2x+22)=180$ .

$6x+30=180$ , so  $6x=150$  and  $x=25$ .

$m\angle 1 = 4(25)+8=108$  and  $m\angle 7 = 2(25)+22=72$ . So  $108^\circ$  and  $72^\circ$ .

### **Problem 11: Are the lines parallel? (alternate interior)**

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The alternate interior angles are equal ( $64^\circ = 64^\circ$ ).

**Yes**,  $a \parallel b$  by the Alternate Interior Angles Converse.

### **Problem 12: Are the lines parallel? (same-side interior)**

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Add the angles:  $112+78=190$ . The sum is not  $180^\circ$ .

**No**, the lines are not parallel, because same-side interior angles of parallel lines must be supplementary.

### **Problem 13: Value of x that makes lines parallel (corresponding)**

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The lines are parallel exactly when corresponding angles are equal:  $5x+4=7x-20$ .

$24=2x$ , so  $x=12$ .

$5(12)+4=64$  and  $7(12)-20=64$ . Each angle is  $64^\circ$ .

### **Problem 14: Value of x that makes lines parallel (alternate exterior)**

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Set the alternate exterior angles equal:  $9x-7=6x+23$ .

$3x=30$ , so  $x=10$ .

$9(10)-7=83$  and  $6(10)+23=83$ . Each angle is  $83^\circ$ .

### **Problem 15: Complete the proof**

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Each missing reason is shown in the table.

| Statements              | Reasons                         |
|-------------------------|---------------------------------|
| $a \parallel b$         | Given                           |
| $m\angle 4 = m\angle 8$ | Corresponding Angles Theorem    |
| $m\angle 8 = m\angle 5$ | Vertical Angles Theorem         |
| $m\angle 4 = m\angle 5$ | Transitive Property of Equality |

### Problem 16: Write a proof of the converse

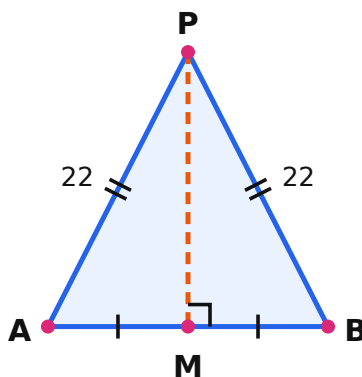
| Statements              | Reasons                                                                      |
|-------------------------|------------------------------------------------------------------------------|
| $m\angle 1 = m\angle 8$ | Given                                                                        |
| $m\angle 1 = m\angle 4$ | Vertical Angles Theorem                                                      |
| $m\angle 4 = m\angle 8$ | Substitution Property of Equality                                            |
| $a \parallel b$         | Corresponding Angles Converse ( $\angle 4$ and $\angle 8$ are corresponding) |

### Problem 17: Perpendicular bisector with algebra

By the Perpendicular Bisector Theorem,  $PA = PB$ :  $3x+4=5x-8$ .

$12=2x$ , so  $x=6$ .

$PA=3(6)+4=22$  and  $PB=5(6)-8=22$ .  $PA=22$ .



Both distances are 22.

### Problem 18: Distance to endpoints

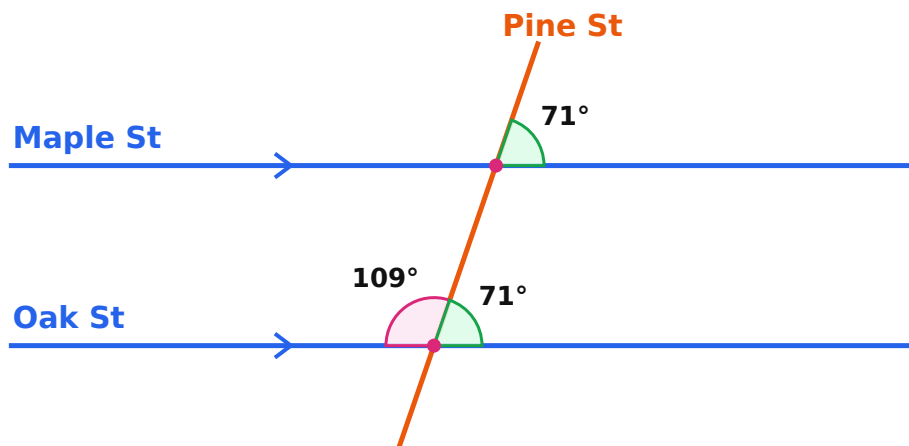
Right triangle  $\triangle PMA$  has legs 12 and 9:  $PA^2=12^2+9^2=144+81=225$ , so  $PA=15$ .

By the Perpendicular Bisector Theorem,  $PB=PA$ .  $PA=PB=15$ .

### Problem 19: Streets problem

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- The northeast angles are corresponding angles, so the angle at Oak Street is  $71^\circ$ .
- The northwest and northeast angles at Oak Street form a linear pair:  $180 - 71 = 109$ . The northwest angle is  $109^\circ$ .



Completed angle measures.

### Problem 20: Railroad crossing

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- Alternate interior angles are equal:  $3x + 2 = 2x + 37$ , so  $x = 35$ .
- $3(35) + 2 = 107$  and  $2(35) + 37 = 107$ . Each is  $107^\circ$ .
- Same-side interior angles are supplementary:  $180 - 107 = 73$ . The angle is  $73^\circ$ .

### Problem 21: Bookshelf brace

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Parallel lines have equal corresponding angles. Here  $83 \neq 85$ .

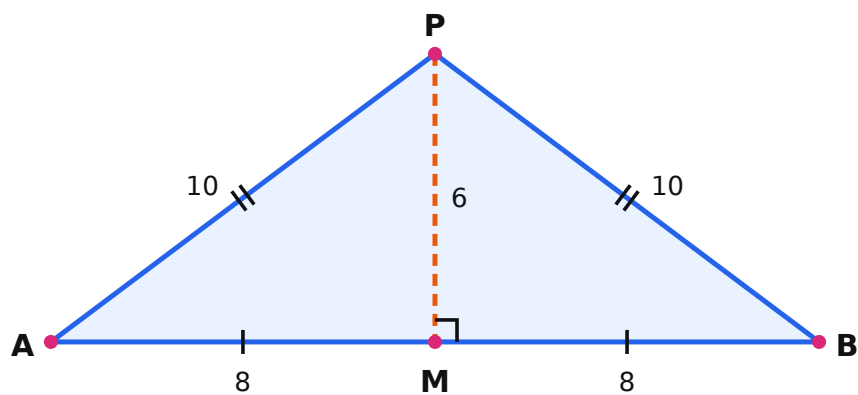
**No**, the shelves are not parallel. They are  $2^\circ$  off, so one shelf must be adjusted.

### Problem 22: Bus stop

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$M$  is the midpoint, so  $AM = 16 \div 2 = 8$ . Right triangle  $\triangle PMA$ :  $PA^2 = 8^2 + 6^2 = 64 + 36 = 100$ , so  $PA = 10$ .

By the Perpendicular Bisector Theorem,  $PB = PA$ . The stop is **10 blocks** from each house.



$PA = PB = 10$  blocks.

### Problem 23: Multi-step angle problem

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$\angle 1$  and  $\angle 5$  are corresponding:  $6x - 12 = 4x + 18$ , so  $2x = 30$  and  $x = 15$ . Then  $m\angle 1 = 6(15) - 12 = 78$  and  $m\angle 5 = 78^\circ$ .

$\angle 4$  and  $\angle 1$  are vertical angles:  $m\angle 4 = 78^\circ$ .

$\angle 5$  and  $\angle 6$  form a linear pair:  $180 - 78 = 102$ , so  $m\angle 6 = 102^\circ$ .

### Problem 24: Notebook paper

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Same-side interior angles are supplementary:  $(6y + 4) + (3y + 14) = 180$ .

$9y + 18 = 180$ , so  $9y = 162$  and  $y = 18$ .

$6(18) + 4 = 112$  and  $3(18) + 14 = 68$ . The angles are  $112^\circ$  and  $68^\circ$ .