

Student Name

Mathematics Stage 4

ANGLE RELATIONSHIPS

Book 3 Identify and describe corresponding,
alternate, and co-interior angles when
2 straight lines are crossed by a transversal

Version: 260207

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OVERVIEW

SYLLABUS CONTENT

MA4-ANG-C-01 applies angle relationships to solve problems, including those related to transversals on sets of parallel lines

Identify and describe corresponding, alternate and co-interior angles when 2 straight lines are crossed by a transversal, including parallel lines

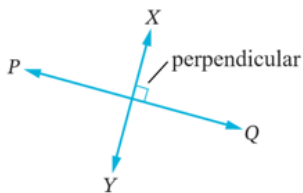
- Identify and describe perpendicular lines using the symbol for is perpendicular to ($\perp$)
- Apply the common conventions to indicate parallel lines on diagrams
- Identify and describe pairs of parallel lines using the symbol for is parallel to ($\parallel$)
- Identify and define transversals, including transversals of parallel lines
- Identify, name and measure alternate angle pairs, corresponding angle pairs and co-interior angle pairs for 2 lines cut by a transversal
- Verify and identify corresponding angles and alternate angles as equal, and co-interior angles as supplementary, when a pair of parallel lines is cut by a transversal
- Justify that 2 lines are parallel by using properties of alternate, corresponding or co-interior angles on parallel lines

SUMMARY

Transversal Angle Properties

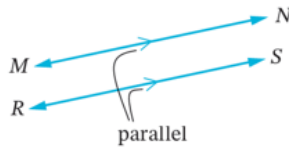
Perpendicular: 90°

$$PQ \perp XY$$



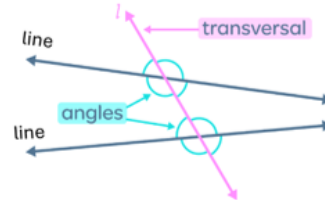
Parallel: same direction

$$MN \parallel RS$$



Transversals

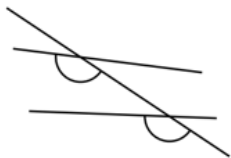
Line that intersects two or more lines



Angle Pairs Formed by Transversals

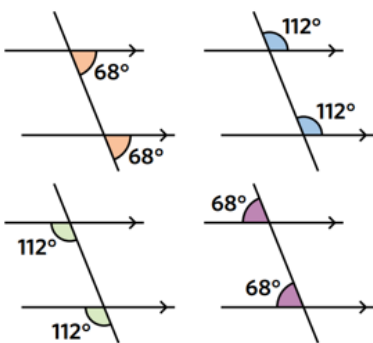
Corresponding

Same side of transversal,
matching positions



If lines are parallel

Corresponding Angles on Parallel Lines are Equal



If corresponding
angles not equal

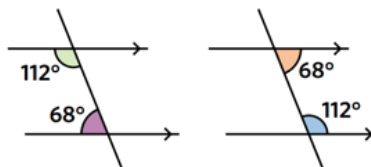
Co-interior

Same side of transversal,
inside the lines



If lines are parallel

Co-interior Angles in Parallel Lines sum to 180°



If co-interior angles
not equal

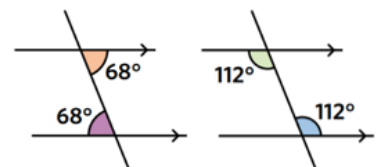
Alternate

Opposite side of transversal,
inside the lines.



If lines are parallel

Alternate Angles on Parallel Lines are Equal



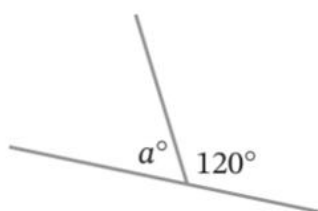
If alternate angles
not equal

Lines Not Parallel

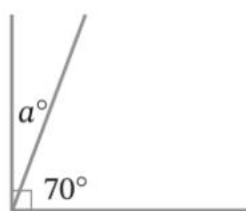
REVIEW OF PRIOR KNOWLEDGE

1 Find the value of the pronumeral.

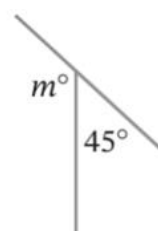
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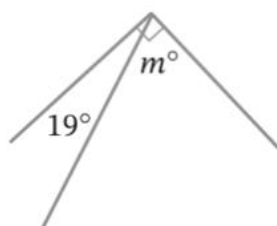
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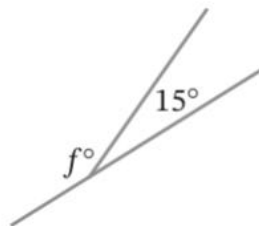
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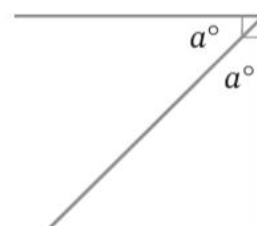
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e



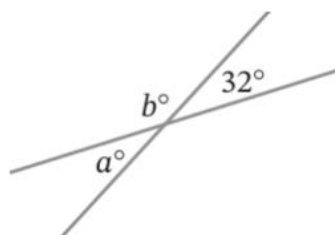
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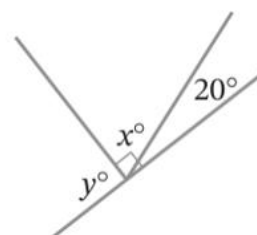
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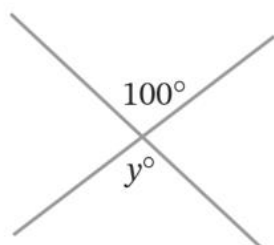
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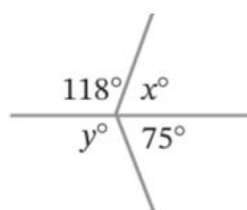
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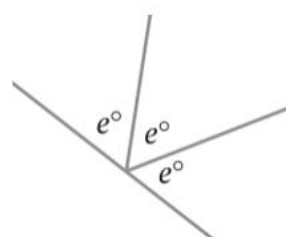
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k



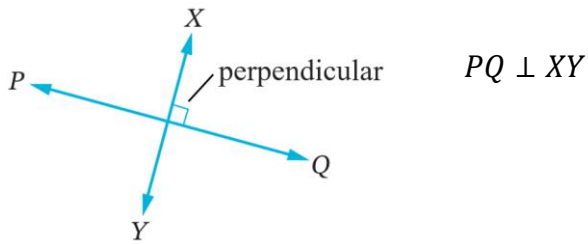
l



PERPENDICULAR AND PARALLEL LINES

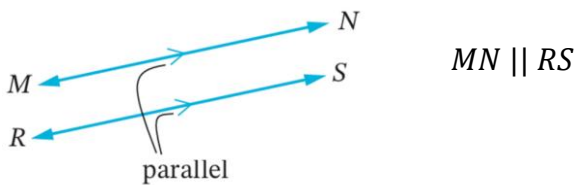
PERPENDICULAR LINES

- **Perpendicular** lines intersect at a **right angle**.
- Diagrams show this with a square; statements use the $\perp$ symbol.



PARALLEL LINES

- **Parallel** lines run in the same direct and never meet, even if extended forever.
- Diagrams show them with arrows $>$; statements use the $\parallel$ symbol.



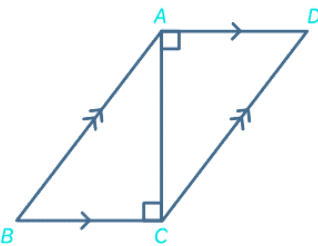
Example Identify perpendicular and parallel lines.

Worked Example	Your Turn
Name a pair of parallel lines. $AB \parallel CD$ Name a pair of perpendicular lines. $AC \perp CD$	Name a pair of parallel lines. Name a pair of perpendicular lines.

Key ideas

1. Parallel lines never, even when extended forever.
2. Parallel lines are shown using, we use the symbol to write a parallel statement.
3. Perpendicular means “meeting at”
4. Perpendicular lines are shown using, we use the symbol to write a perpendicular statement.

1 Complete the statements:



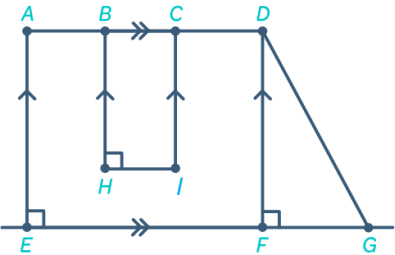
- a DA is parallel to
- b AB is to CD
- c AC is perpendicular to and

CB

parallel

BC and AD

2 Consider the diagram of a swing set on the right.

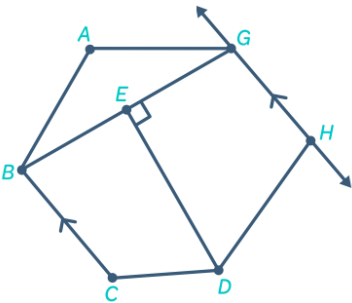


- a How many line segments are parallel to AE?
- b Identify 2 line segments perpendicular to EG.

3: BH, CI, DF

AE or DF

3 Consider the diagram to the right.

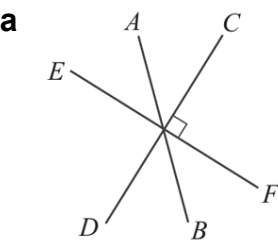


- a Name a line segment parallel to GH
- b Identify a line segment perpendicular to GE

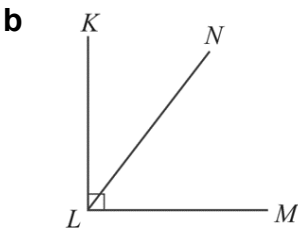
BC

DE

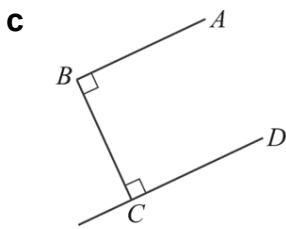
4 Name all the pairs of perpendicular lines in the following diagrams.
Write a statement like $WX \perp YZ$



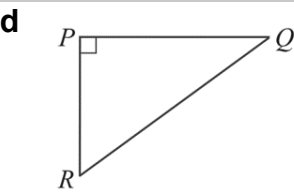
$CD \perp EF$



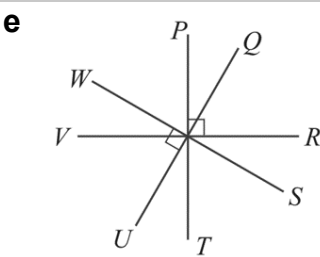
$KL \perp LM$



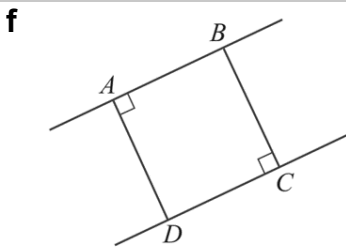
$AB \perp BC, BC \perp CD$



$RP \perp PQ$



$PT \perp PR, WS \perp UQ$

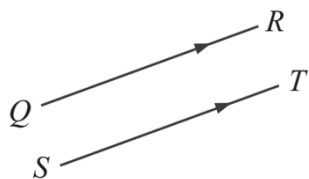


$AB \perp AD, BC \perp DC$

5 Name the pairs of parallel lines in these diagrams.

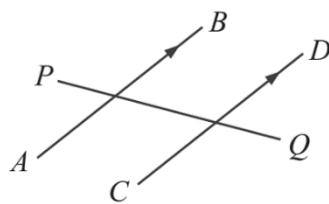
Write a statement like $WX \parallel YZ$

a



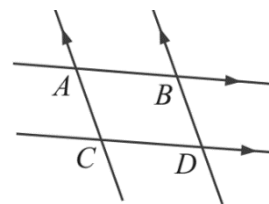
$QR \parallel ST$

b



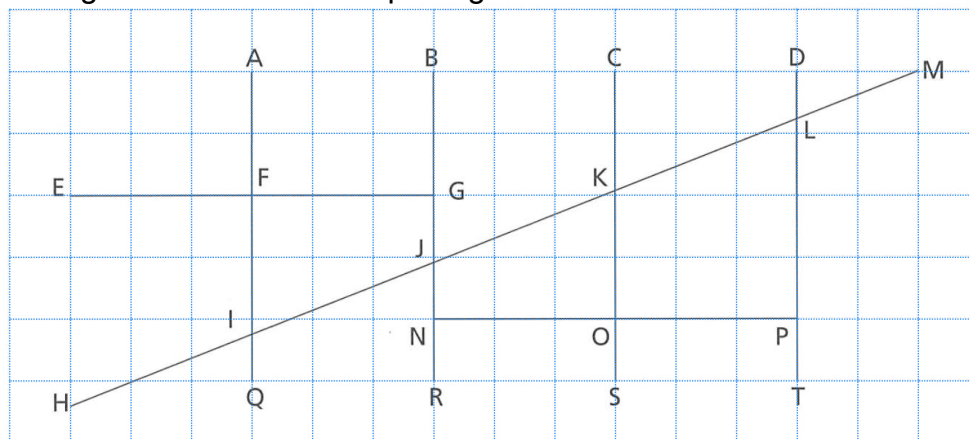
$AB \parallel CD$

c



$AB \parallel CD, AC \parallel BD$

6 A diagram is drawn on a square grid.



Decide whether these statements are true or false.

a AQ is parallel to BR.

true

b NP is perpendicular to CS.

true

c BR is perpendicular to HM.

false

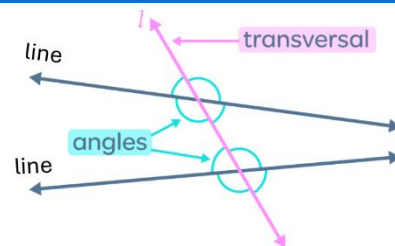
d BR is parallel to DT.

true

e Add arrows and right-angle symbols to show parallel and perpendicular lines.

ANGLES ON TRANSVERSALS

- A **transversal** is a line that intersects two or more lines.
- It forms 3 types of angles at the points of intersection:
 - **Corresponding** angles
 - **Alternate** angles
 - **Co-interior** angles



Corresponding Pairs	Alternate Pairs	Co-interior Pairs
Transversal →	Transversal →	Transversal →
Matching positions on same side of transversal.	Opposite sides of transversal, inside the lines.	Same side of transversal, inside the lines.

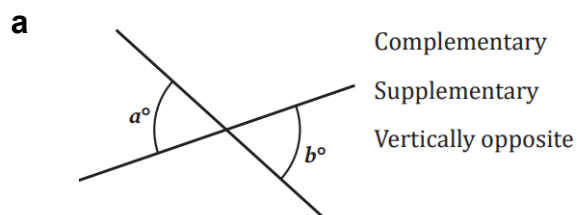
Example Classify angles on transversals.

Matching positions on same side of transversal. Corresponding.	Same side of transversal inside the lines. Co-interior.
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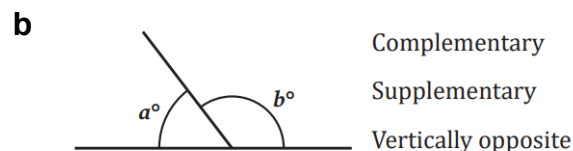
Classify these angle relationships.

a corresponding	b alternate	c co-interior	d corresponding
e co-interior	f alternate	g alternate	h corresponding

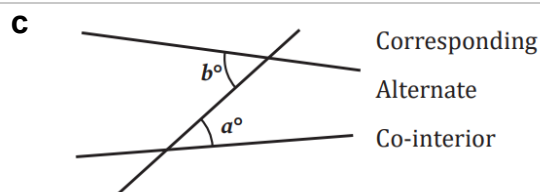
1 Identify the angle relationship shown.



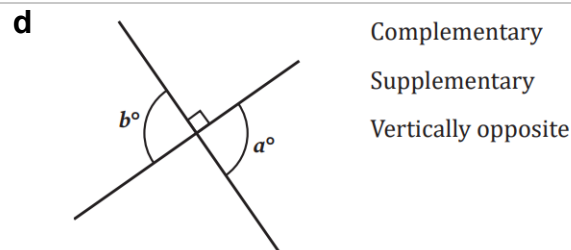
vertically opposite



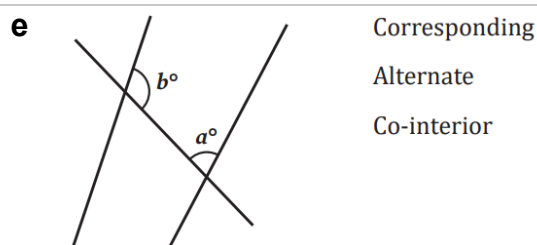
Supplementary



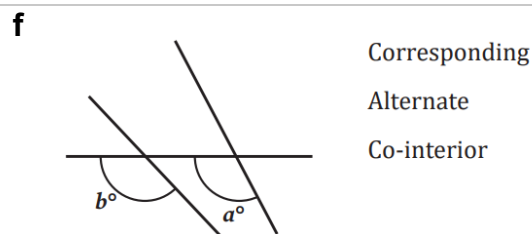
alternate



vertically opposite

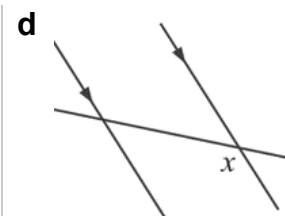
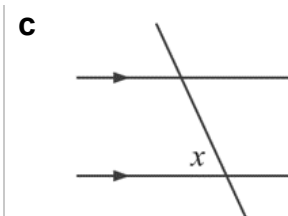
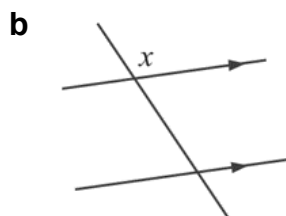
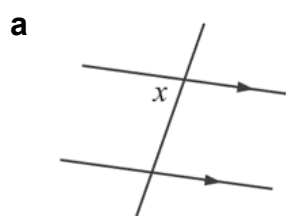


co-interior

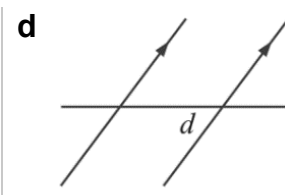
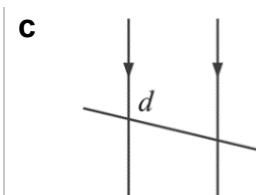
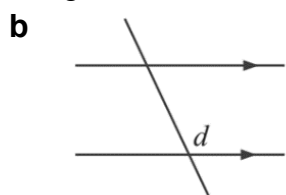
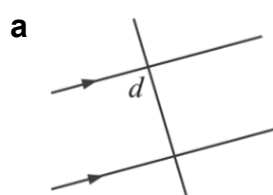


corresponding

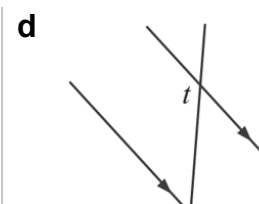
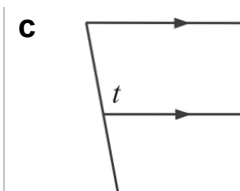
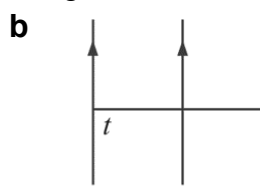
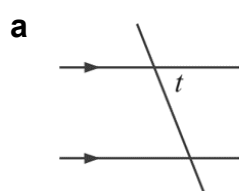
2 Draw an arc showing the angle corresponding to x .



3 Draw an arc showing the angle alternate to d .

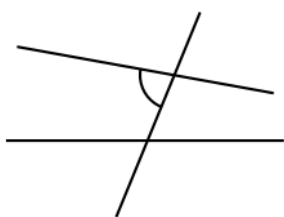


4 Draw an arc showing the angle co-interior to t .

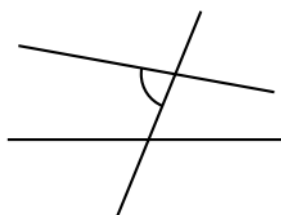


- 5** Label the missing angle arc for the corresponding, alternate, or co-interior angle.
There can be more than one answer, or no answer.

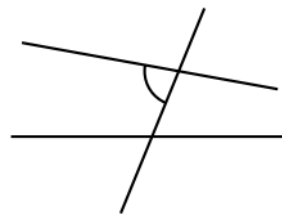
a Corresponding



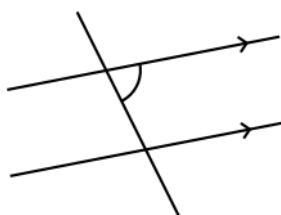
b Alternate



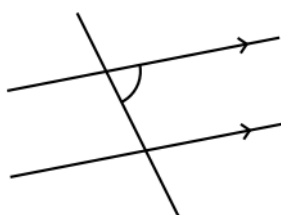
c Co-interior



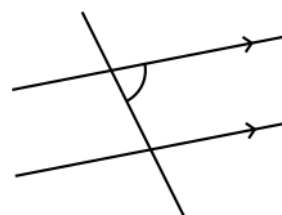
d Corresponding



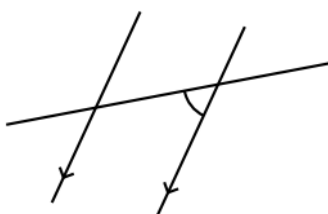
e Alternate



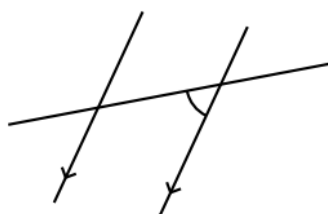
f Co-interior



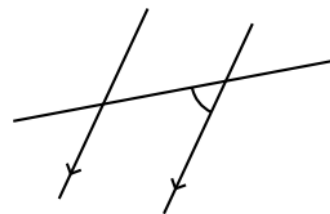
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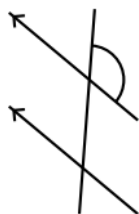
h Alternate



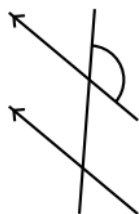
i Co-interior



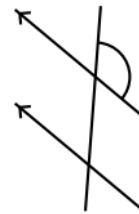
j Corresponding



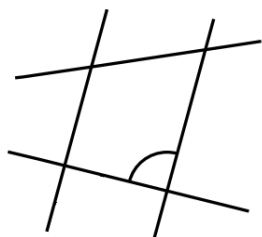
k Alternate



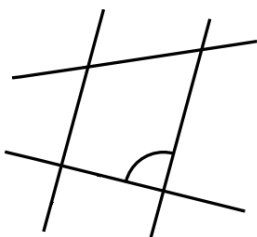
l Co-interior



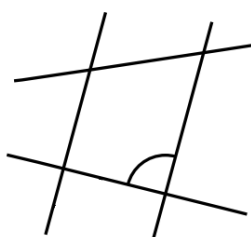
m Corresponding



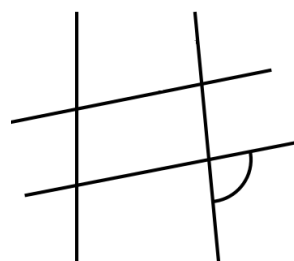
n Alternate



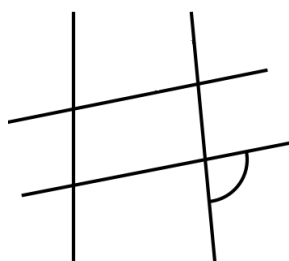
o Co-interior



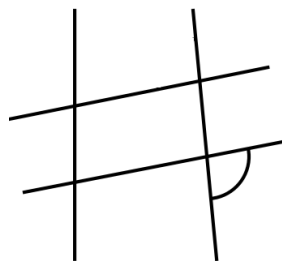
p Corresponding



q Alternate

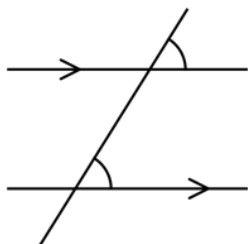


r Co-interior



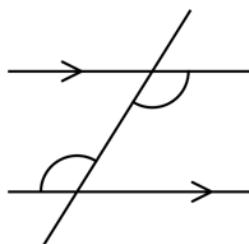
6 Identify whether these angles are corresponding, alternate, or co-interior.

a



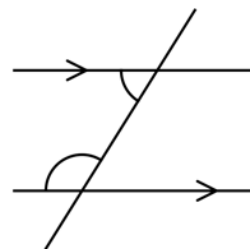
corresponding

b



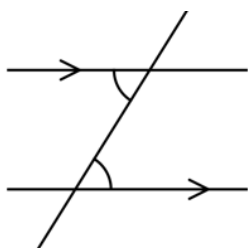
alternate

c



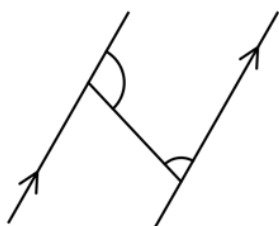
co-interior

d



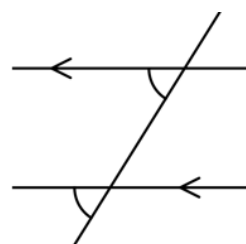
alternate

e



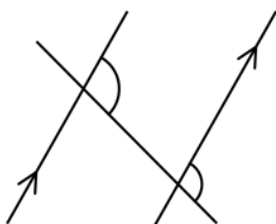
co-interior

f



corresponding

g



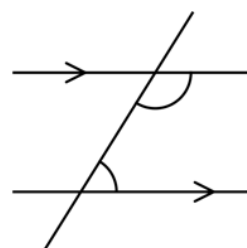
corresponding

h



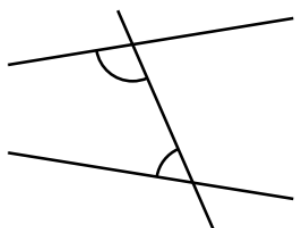
co-interior

i



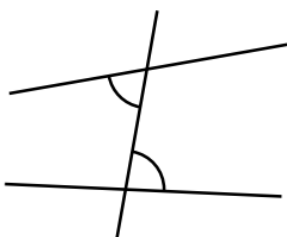
co-interior

j



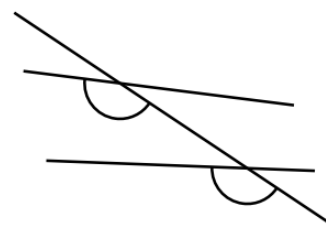
co-interior

k



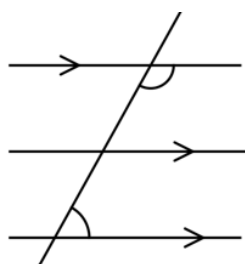
alternate

l



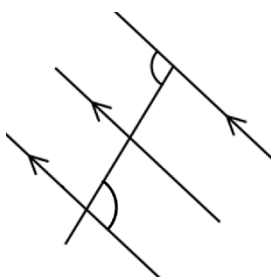
corresponding

m



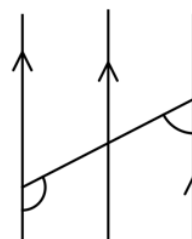
co-interior

n



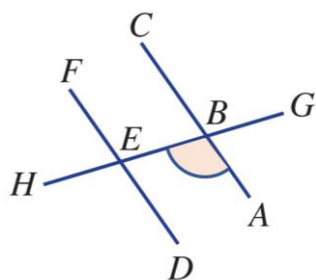
alternate

o



co-interior

7 Referring to the angle indicated, name the angle that is:



a Vertically opposite $\angle CBG$

b Corresponding

c Alternate

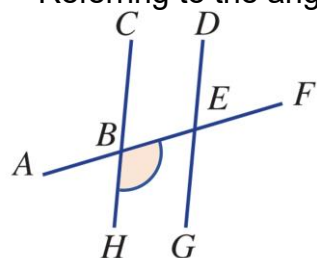
d Co-interior

$\angle HED$

$\angle FEB$

$\angle BED$

8 Referring to the angle indicated, name the angle that is:



a Vertically opposite

b Corresponding

c Alternate

d Co-interior

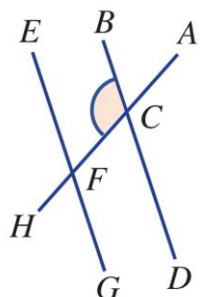
$\angle ABC$

$\angle GEF$

$\angle DEA$

$\angle GEB$

9 Referring to the angle indicated, name the angle that is:



a Vertically opposite

b Corresponding

c Alternate

d Co-interior

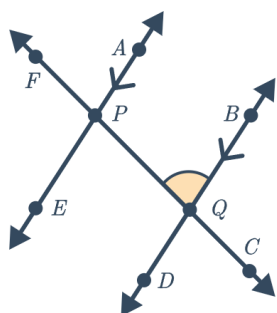
$\angle ACD$

$\angle EFH$

$\angle GFA$

$\angle EFA$

10 Referring to the angle indicated, name the angle that is:



a Vertically opposite

b Corresponding

c Alternate

d Co-interior

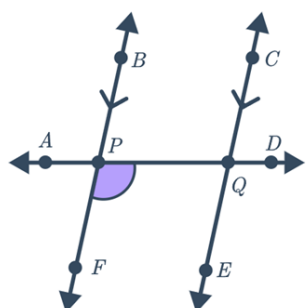
$\angle DQC$

$\angle FPA$

$\angle EPC$

$\angle APC$

11 Referring to the angle indicated, name the angle that is:



a Vertically opposite

b Corresponding

c Alternate

d Co-interior

$\angle APB$

$\angle EQD$

$\angle CQA$

$\angle EQA$

PARALLEL LINES AND TRANSVERSALS

✧ Angles formed by Transversals: <https://www.geogebra.org/m/prtpj5mw>

Corresponding	Alternate	Co-interior
Corresponding angles on parallel lines are equal.	Alternate angles on parallel lines are equal.	Co-interior angles between parallel lines sum to 180°

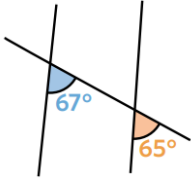
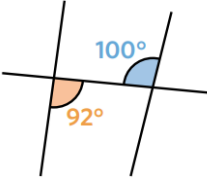
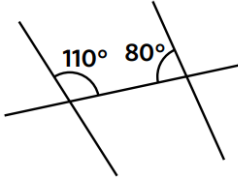
Example Calculate angles using parallel line properties.

$x = 125$ (corresponding angles on lines)	$128 + x = 180$ (co-interior angles in lines) $x = 52$
--	--

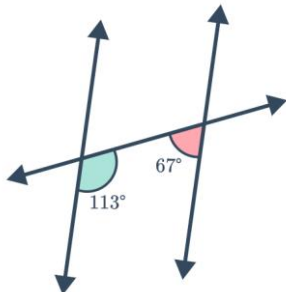
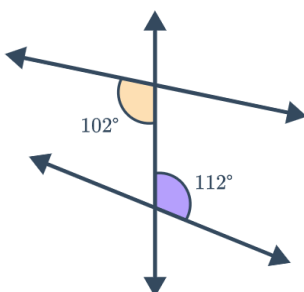
Find the value of the unknown angle. Give a brief reason.

a $a = 80^\circ$ (corresponding angles on lines)	b $b = 120^\circ$ (corresponding angles on lines)	c $c = 131^\circ$ (corresponding angles on lines)
d $g = 100^\circ$ (co-interior angles in lines)	e $d = 82^\circ$ (alternate angles on lines)	f $h = 129^\circ$ (co-interior angles on lines)

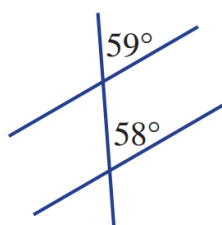
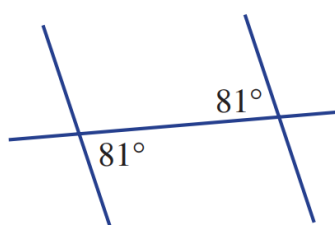
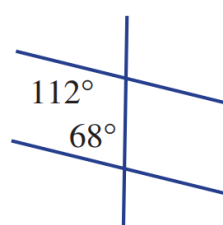
DECIDE WHETHER TWO LINES ARE PARALLEL

Not Parallel		
If corresponding angles are not equal, then the lines are not parallel. 	If alternate angles are not equal, then the lines are not parallel. 	If co-interior angles do not sum to 180°, then the lines are not parallel. 

Example Determine whether two lines are parallel.

Determine whether these two lines are parallel.	
 The co-interior angles sum to 180°. Parallel.	 Alternate angles are not equal. Not parallel.

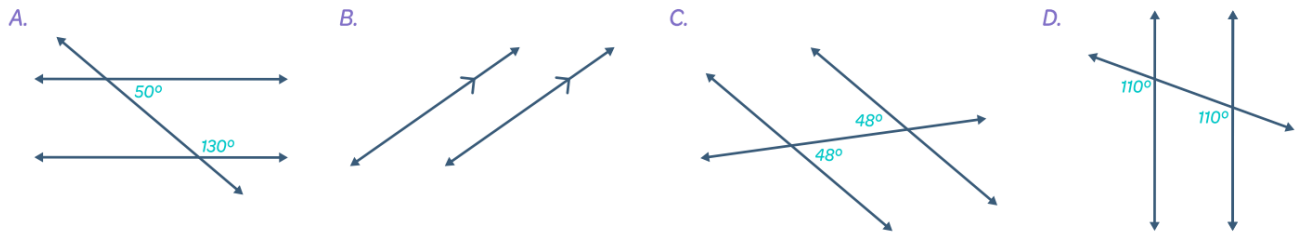
Determine whether these lines are parallel. Give a reason for your answer.

a  No, corresponding angles not equal.	b  Yes, corresponding angles are equal.	c  Yes, co-interior angles sum to 180°.
--	---	---

Key ideas

- Corresponding angles on parallel lines are always
- Alternate angles on parallel lines are always
- Co-interior angles between parallel lines always
- If corresponding angles are not equal, alternate angles are not equal, and co-interior angles do not sum to 180° , then the lines are not
- We can also use these properties to find unknown if we know that two lines are parallel.

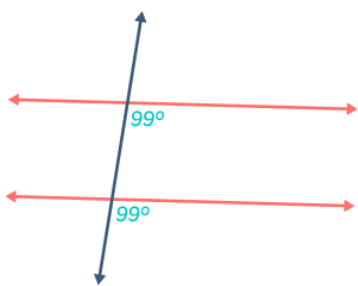
1 Match the diagram to the reason why the lines are parallel.



- Alternate angles are equal.
- Corresponding angles are equal.
- Co-interior angles add to 180°.
- The diagram shows parallel line markings.

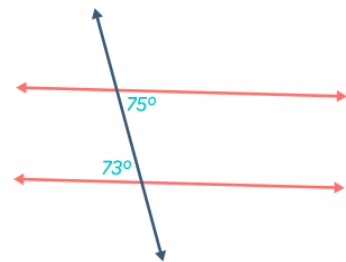
C
D
A
B

2 Complete these statements.



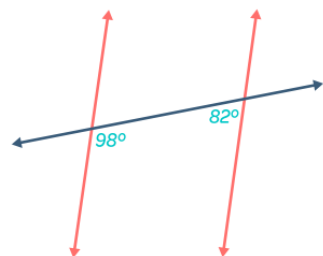
a The alternate | corresponding | co-interior angles are | aren't equal, so the lines are | aren't parallel.

The corresponding angles are equal, so the lines are parallel.



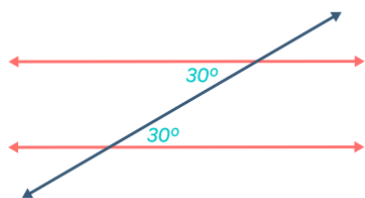
b The angles equal, so the lines parallel.

The alternate angles aren't equal, so the lines aren't parallel



c The angles add to 180, so the lines parallel.

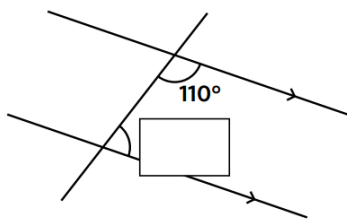
The co-interior angles don't add to 180, so the lines aren't parallel



d The angles equal, so the lines parallel.

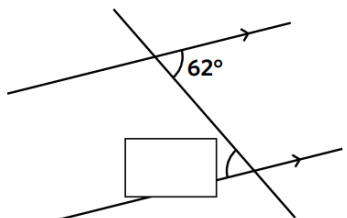
The alternate angles aren't equal, so the lines aren't parallel.

3 Calculate the value of the missing angle and give a reason.



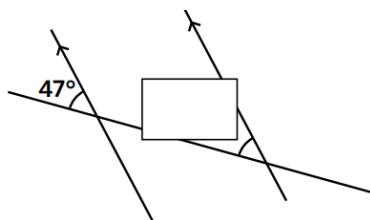
a angles
between parallel lines sum to 180°

70° , cointerior



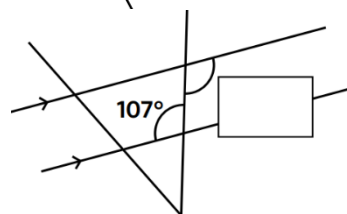
b angles
between parallel lines are equal.

62° , alternate



c angles
in parallel lines are equal.

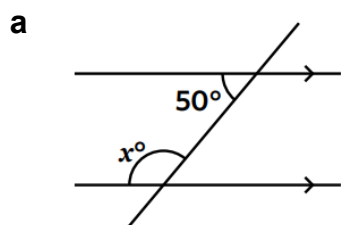
47° , corresponding



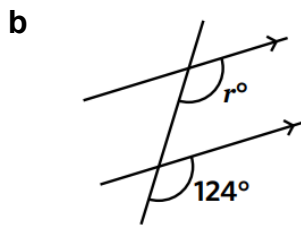
d angles
between parallel lines are equal.

107° , alternate

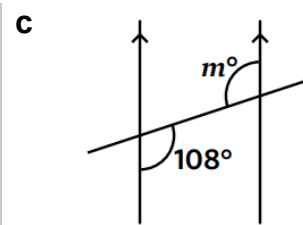
4 Calculate the value of the missing angle and give a reason.



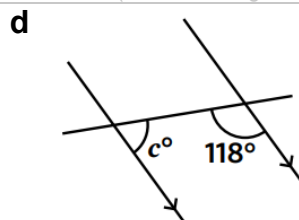
130° (co-interior angles in parallel lines)



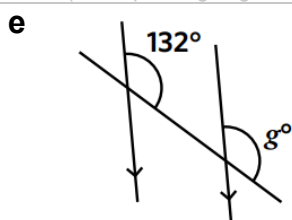
124° (corresponding angles on parallel lines)



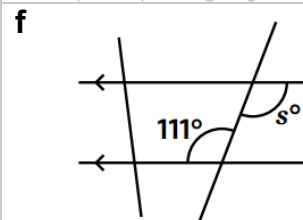
108° (corresponding angles on parallel lines)



62° (co-interior angles in parallel lines)



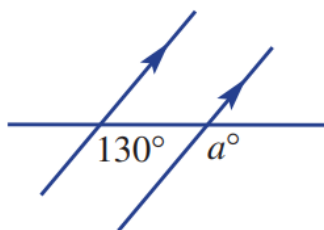
132° (corresponding angles on parallel lines)



111° (alternate angles on parallel lines)

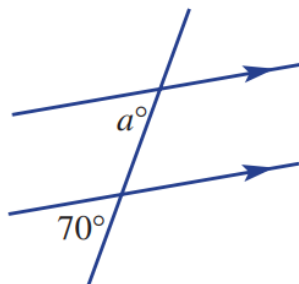
5 For each diagram, calculate the value of the missing angles. Give a brief reason.

a



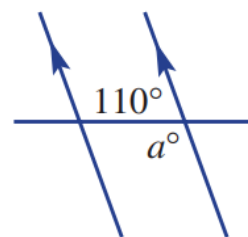
130 (corresponding angles on parallel lines)

b



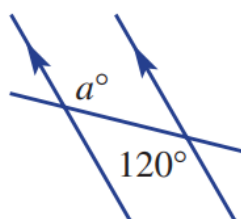
70 (corresponding angles on parallel lines)

c



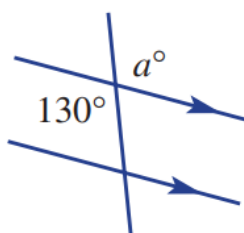
110 (alternate angles on parallel lines)

d



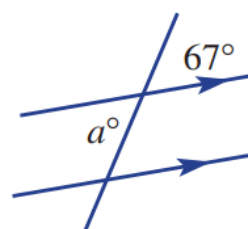
120 (alternate angles on parallel lines)

e



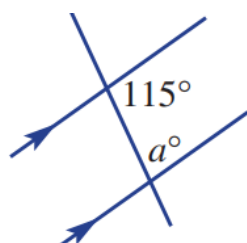
130 (vertically opposite angles)

f



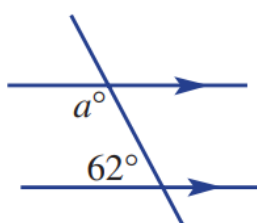
67 (vertically opposite)

g



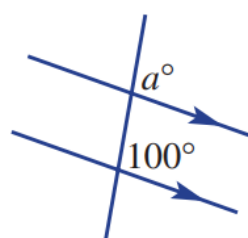
65 (co-interior angles between parallel lines)

h



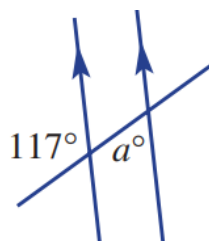
118 (co-interior angles between parallel lines)

i



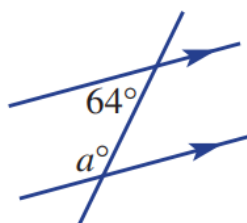
100 (corresponding angles on parallel lines)

j



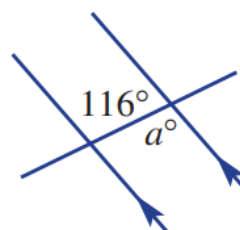
117 (vertically opposite angles)

k



116 (co-interior angles between parallel lines)

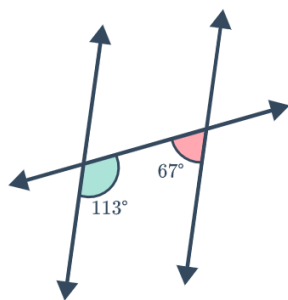
l



64 (angles on a straight line)

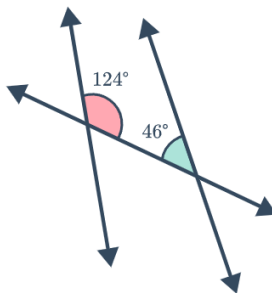
- 6 For each diagram, state whether the diagram has parallel lines. Justify your answer using angle relationships.

a



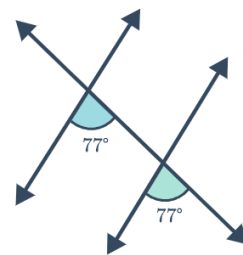
Yes. Co-interior angles sum to 180°

b



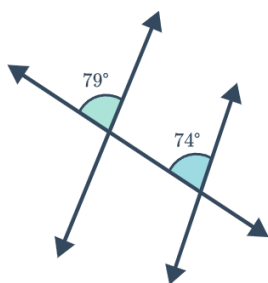
No. Co-interior angles don't sum to 180°

c



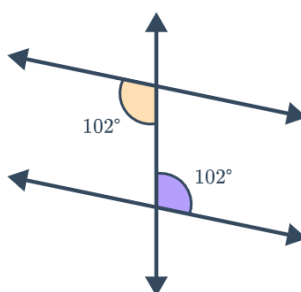
Yes. Corresponding angles are equal

d



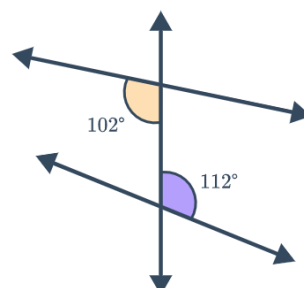
No. Corresponding angles aren't equal

e



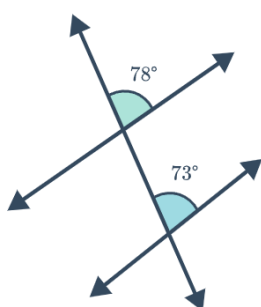
Yes. Alternate angles are equal

f



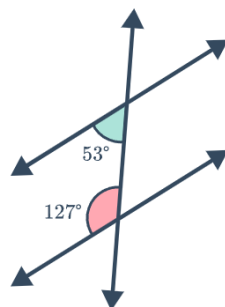
No. Alternate angles aren't equal

g



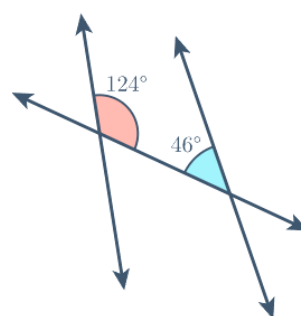
No. Corresponding angles aren't equal

h



Yes. Co-interior angles sum to 180°

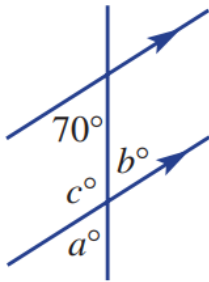
i



No. Co-interior angles don't sum to 180°

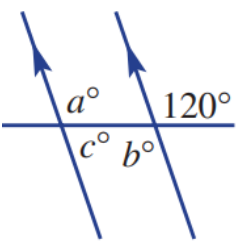
7 Calculate the value of each unknown angle in the diagram. You do not need to show reasoning.

a



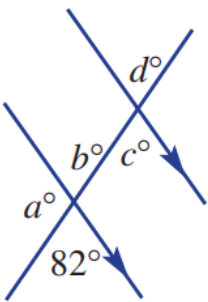
$a = 70$
 $c = 110$
 $b = 70$

b



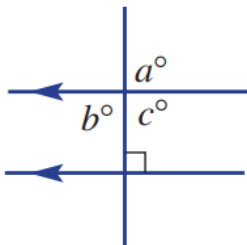
$a = 120$
 $b = 120$
 $c = 60$

c



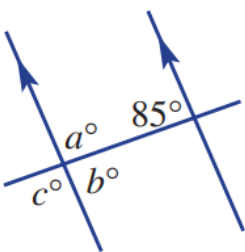
$a = 98$
 $b = 82$
 $c = 82$
 $d = 82$

d



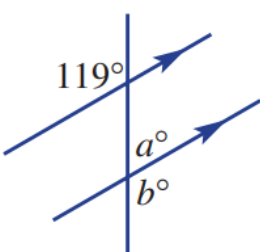
$a = 90$
 $b = 90$
 $c = 90$

e



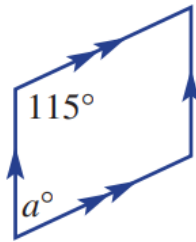
$a = 95$
 $b = 85$
 $c = 95$

f



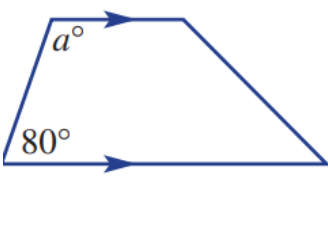
$b = 119$
 $a = 61$

g



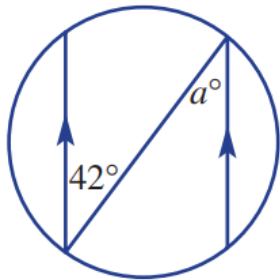
$a = 65$

h



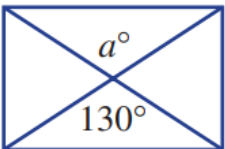
$a = 100$

i



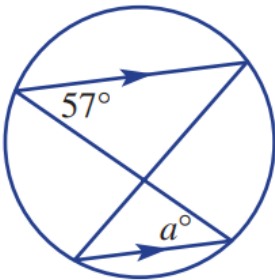
$a = 42$

j



$a = 130$

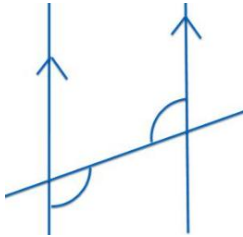
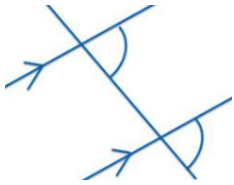
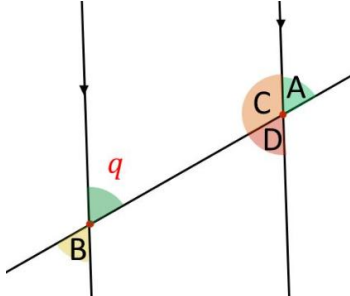
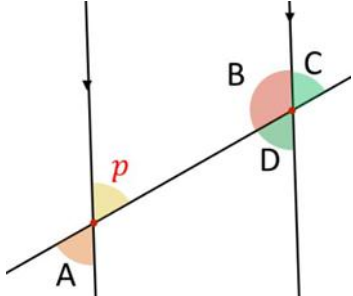
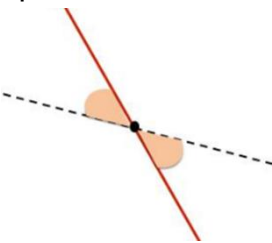
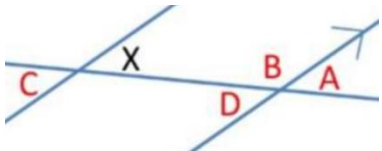
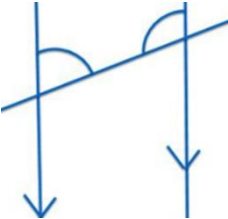
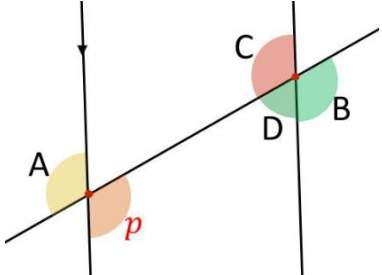
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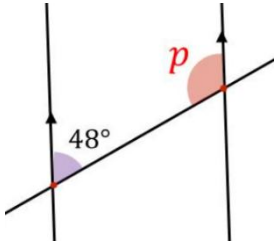
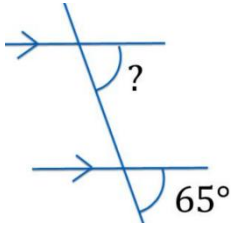
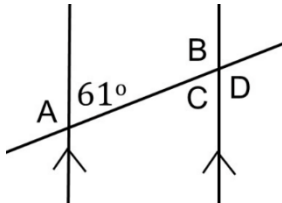
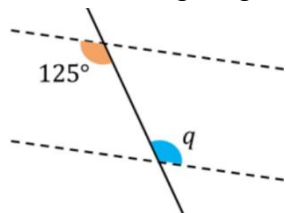
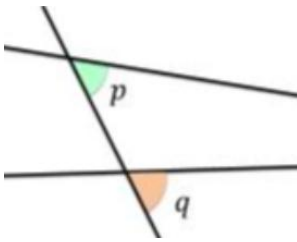
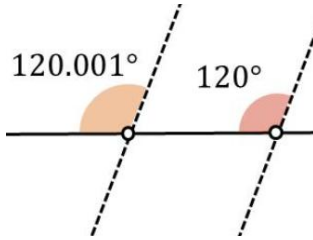
$a = 57$

CHECK YOUR UNDERSTANDING

Angles on transversals

1 Which is the relationship between the two angles? a Alternate b Corresponding c Co-interior d Vertically opposite 	2 Which is the relationship between the two angles? a Alternate b Corresponding c Co-interior d Vertically opposite 
3 Which angle is alternate to q? a b c d 	4 Which angle is corresponding to p? a b c d 
5 Which is the relationship between the two angles? a Alternate b Corresponding c Co-interior d Vertically opposite 	6 Which angle is co-interior to p? a b c d 
7 Which is the relationship between the two angles? a Alternate b Corresponding c Co-interior d Vertically opposite 	8 Which angle is co-interior to p? a b c d 

Transversal angle properties on parallel lines

1 What is the value of p? a 132° b 128° c 48° d Not enough information 	2 What is the value of the missing angle? a 115° b 65° c 125° d 295° 
3 Which angle is also 61°? a b c d 	4 What is the value of the missing angle? a 55° b 130° c 125° d Not enough information 
5 Jo says the angles are corresponding. Paul says the angles are equal. Who is correct? a Only Jo b Only Paul c Both d Neither 	
6 Jo says the lines are parallel. Paul says they will eventually intersect. Who is correct? a Only Jo b Only Paul c Both d Neither 	
7 Jo says the lines are parallel. Paul says they will eventually intersect. Who is correct? a Only Jo b Only Paul c Both d Neither 