

Exploring Parallel Lines and a Transversal

Mathematics Learning Objectives:

- Students will be able to identify relationships of angles formed by two parallel lines cut by a transversal.
- Students will be able to recognize statistical questions that are answered by estimating a population mean or a population proportion.

Essential Question:

- Are there any special angle relationships formed when two lines are cut by a transversal?

Common Core Mathematics Standards:

- Make sense of problems and persevere in solving them.
- Construct viable arguments and critique the reasoning of others.
- Use appropriate tools strategically.
- Look for and make use of structure.

Materials:

- Instructor computer with web access and interactive whiteboard or overhead display
- GeoGebra work pages (for projecting overhead and for students to load on their own devices):
 - Linear Pair of Angles: <https://ggbm.at/fpxntsha>
 - Vertical Angles: <https://ggbm.at/mrpmt2jx>
 - Angle Pairs: <https://ggbm.at/vsjtu72t>
- Student laptop computers with internet access (for loading GeoGebra)
- Course website with links to GeoGebra work pages (for students' easy access)
- Guided Practice worksheet (Angle Pair Guided Practice) (see addendum)
- Independent Practice worksheet (Kuta- Parallel Lines and Transversals) (see addendum)

Notes to the reader:

- Students should have previously learned the definition of complementary angles, supplementary angles, and congruent angles
- Students should be able to use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.
- Have the GeoGebra work pages loaded and ready for projecting overhead during the exploration.

Detailed Plan for Instructional Time:

Time	What is the teacher doing? (Be sure to include questions the teacher will ask and academic language supports and details of technologies or other materials used)	What are students doing? If they are interacting with a technology tool or other materials, please describe.
5 min	<p>Warmup Have the directions for the warmup written on the board or projected on screen:</p> <p>Direct them to think about any angle relationships they see.</p>	<p>Sketch two parallel lines and a third line intersecting those two lines (transversal) on your own paper.</p> <p>Come up with some conjectures about any angle relationships you see.</p> <p>Discuss your conjectures with a partner.</p>
10 min	<p>Identifying angle pairs Project the GeoGebra work page “Linear Pair of Angles”. https://ggbm.at/fpxntsha Have the class discuss the following questions together:</p> <ol style="list-style-type: none"> 1. What do you notice about the location of the linear angles? 2. What do you observe about the angle measures of the linear angles? 3. A linear pair of angles has two important characteristics. Based on your answers to questions 1 and 2, can you identify these characteristics? <p>Optionally, have students come up to the interactive white board or computer and manipulate the angles.</p> <p>Next, project the GeoGebra work page “Vertical Angles”. https://ggbm.at/mrpmt2jx Have the class discuss any angle relationships.</p> <p>Finally, project the GeoGebra work page “Angle Pairs”. https://ggbm.at/vsju72t The class will discuss and identify the characteristics of each pair of angles. For example, for alternate interior angles, the class should discuss what the words "alternate" and "interior" mean individually.</p>	<p>This part is a whole class exploration.</p> <p>Students should be able to identify the two main characteristics of a linear pair of angles (they are adjacent and supplementary).</p> <p>Students should be able to determine that vertical angles are congruent.</p> <p>Students should be able to identify alternate interior angles formed by two lines cut by a transversal.</p>
15 min	<p>Part 1: Investigating angle relationships made when a transversal crosses two parallel lines.</p>	<p>Students will open the GeoGebra work page “Parallel Lines” using the link on the class website.</p>

	<p>Have students work in pairs for this section.</p>	<p>Students will form as many conjectures as they can about the angle relationships formed by two parallel lines cut by a transversal.</p> <p>Students record their conjectures in their notebooks.</p> <p>Students then pair with a partner to compare and discuss their conjectures.</p>
15 min	<p>Part 2: Investigate angle relationships made by parallel lines crossed by a transversal.</p> <p>Make sure each student has found the links to the GeoGebra work pages and can work independently on this exploration.</p> <p>Students facing technical difficulties may be paired with another student.</p>	<p>Students work individually for this part.</p> <p>Students navigate to the course website where links are provided to a series of GeoGebra work pages. They use the figures and guiding questions on each GeoGebra work page to investigate each type of angle pair and confirm or revise the conjectures they made in the previous part of this lesson. Students record their responses in their notebooks.</p> <ol style="list-style-type: none"> 1. Use points A, B, and C to move the lines. Observe the angle values. 2. Compare different pairs of related angles. What do you notice? <p>Students perform this exploration for corresponding angles, alternate interior angles, alternate exterior angles, same-side interior angles, and same-side exterior angles.</p>
5 min	<p>Part 3: Lead a class discussion in summarizing angle relationships.</p>	<p>Students should be able to draw these conclusions:</p> <ul style="list-style-type: none"> • <u>Linear pair of angles</u> are adjacent and supplementary • <u>Vertical angles</u> are congruent • <u>Corresponding angles</u> are congruent • <u>Alternate interior angles</u> are congruent • <u>Same side interior angles</u> are supplementary • <u>Alternate exterior angles</u> are congruent • <u>Same side exterior angles</u> are supplementary
10 min	<p>Part 4: Guided practice</p>	

	<p>Provide students with the “Angle Pair Guided Practice” exercises. (The exercises are attached to this document, and can be distributed to students.)</p> <p>Circulate among students to observe work. After 5 minutes, go over answers with the class. (Answers are attached to this document).</p>	<p>Students work independently on worksheet exercises. They may occasionally turn to a friend for some guidance.</p>
	<p>Independent Practice (Homework)</p> <p>Provide students with the ‘Parallel Lines and Transversals’ worksheet to find missing angle measures in questions #11 - 18. (Worksheet is attached to this document, and can be distributed to students.)</p>	

Screenshots:

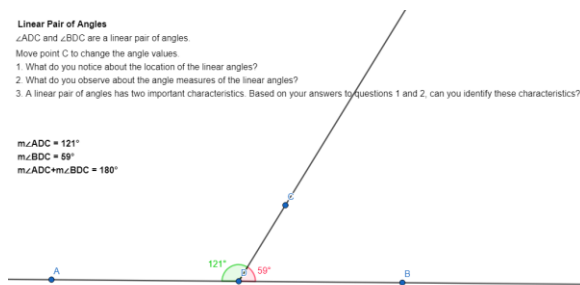


Figure 1: Linear Pairs of Angles (GeoGebra work page)

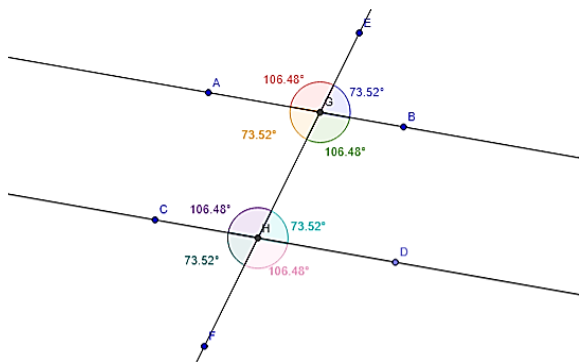


Figure 2: Angles Created by Parallel Lines and a Transversal (GeoGebra work page)

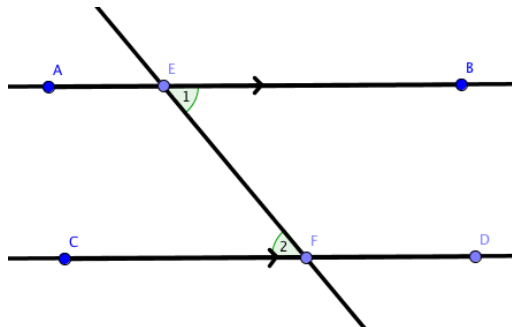
Resources:

- Lesson adapted from CPALMS lesson resource 39484, available online at <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/39484>
- Independent Practice worksheet “Parallel Lines and Transversals” by Kuta, available online at <https://cdn.kutasoftware.com/Worksheets/Geo/3-Parallel%20Lines%20and%20Transversals.pdf>
- GeoGebra constructions informed in part by exercises presented in <https://cdn.geogebra.org/material/2sSJL5PICihI6kRFesS8XzoYulm0cycyT/material-K7z5um4B.pdf>

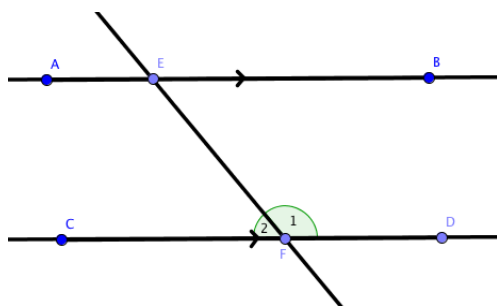
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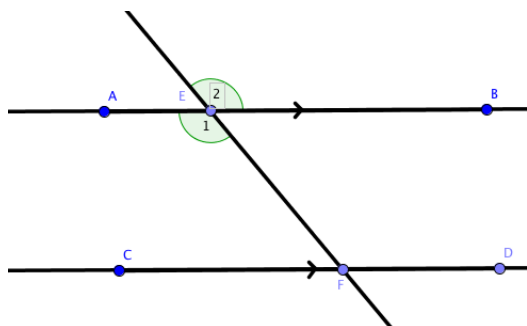
1. What kind of angle pair do angles 1 and 2 form? What is their relationship?



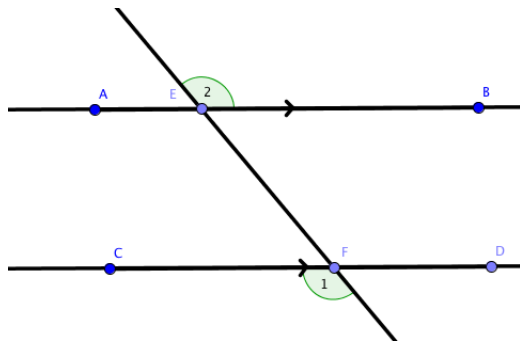
2. What kind of angle pair do angles 1 and 2 form? What is their relationship?



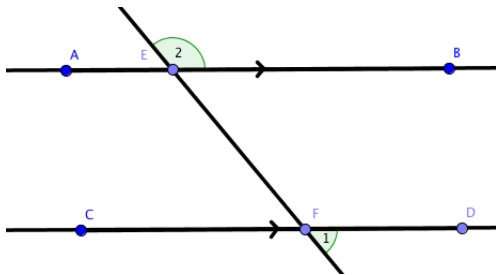
3. What kind of angle pair do angles 1 and 2 form? What is their relationship?



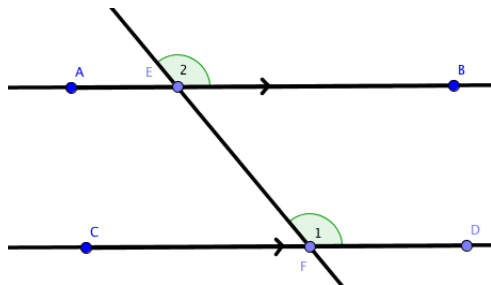
4. What kind of angle pair do angles 1 and 2 form? What is their relationship?



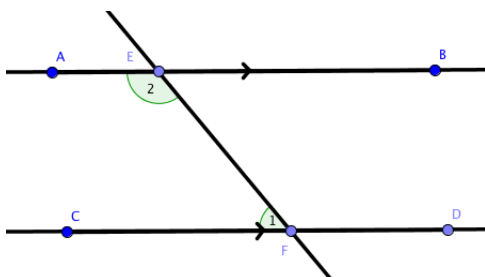
5. What kind of angle pair do angles 1 and 2 form? What is their relationship?



6. What kind of angle pair do angles 1 and 2 form? What is their relationship?



7. What kind of angle pair do angles 1 and 2 form? What is their relationship?



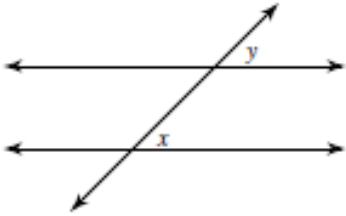
Answers to Angle Pair Guided Practice:

1. Alternate interior angles, they are congruent
2. Linear pair of angles, they are supplementary
3. Vertical angles, they are congruent
4. Alternate exterior angles, they are congruent
5. Same-side exterior angles or consecutive exterior angles, they are supplementary
6. Corresponding angles, they are congruent
7. Same-side interior angles or consecutive interior angles, they are supplementary

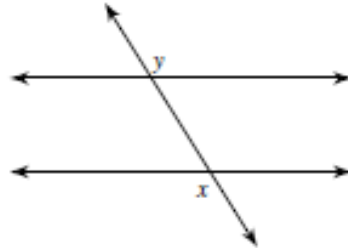
Parallel Lines and Transversals

Identify each pair of angles as corresponding, alternate interior, alternate exterior, or consecutive interior.

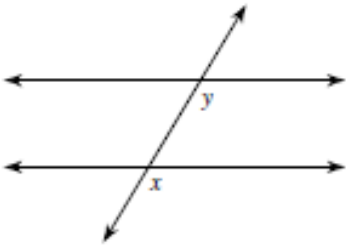
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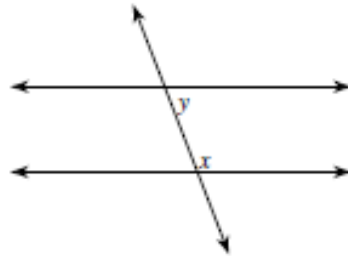
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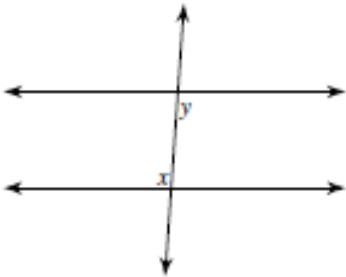
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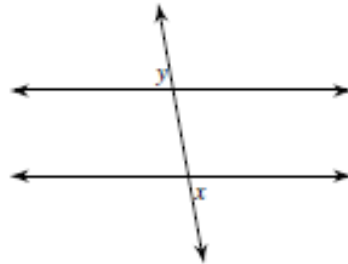
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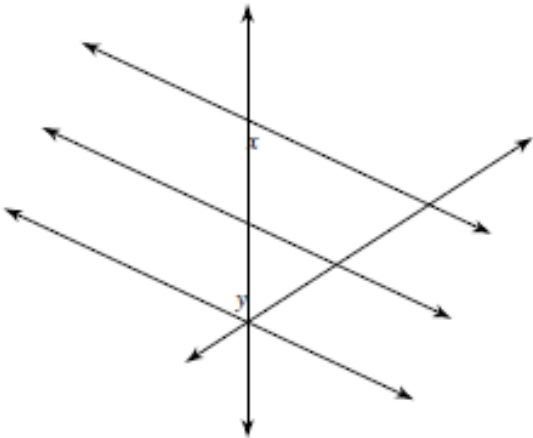
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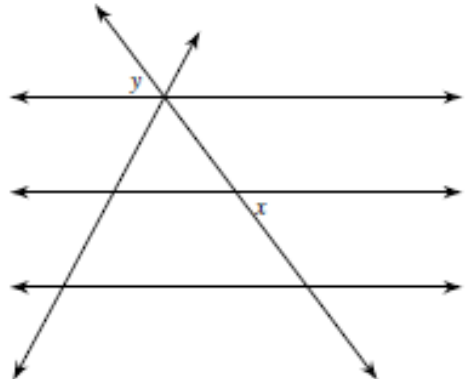
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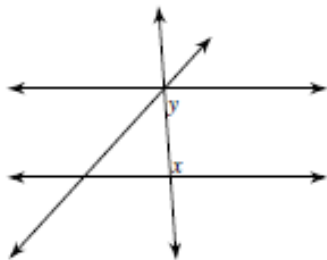
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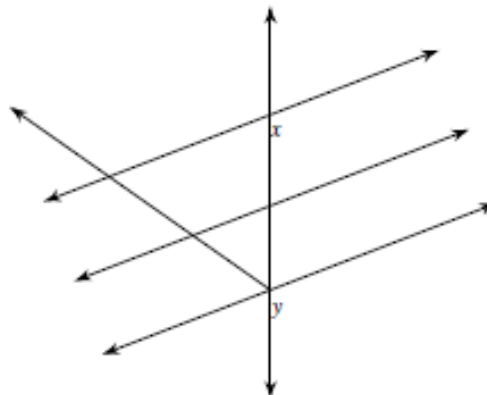
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9)

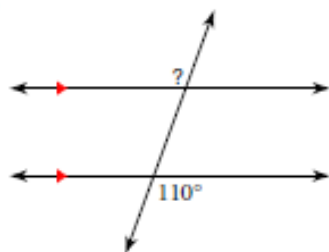


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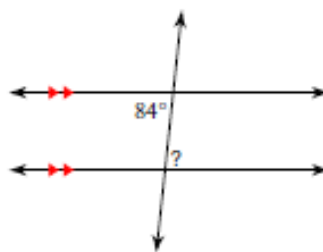


Find the measure of each angle indicated.

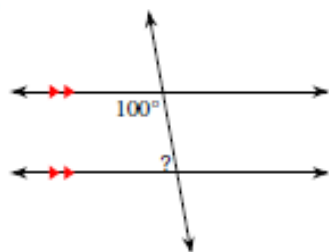
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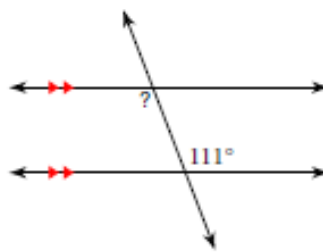
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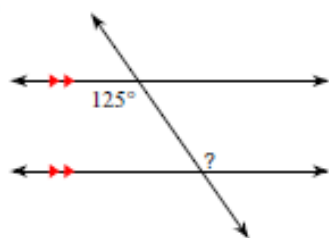
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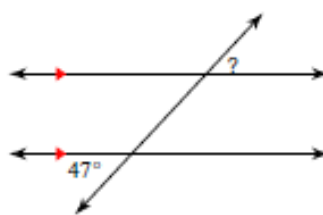
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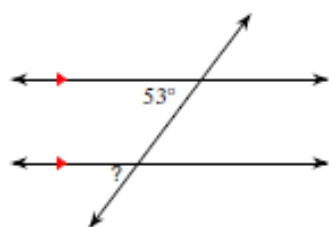
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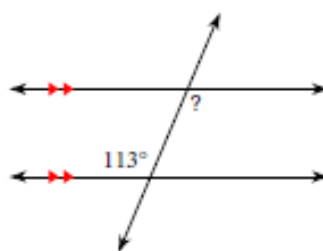
16)



17)

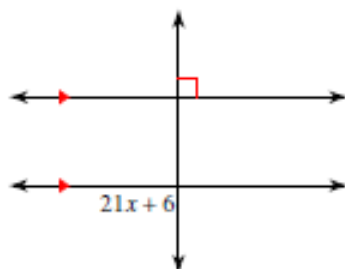


18)

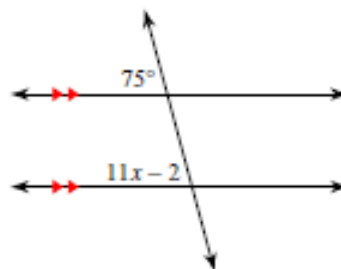


Solve for x .

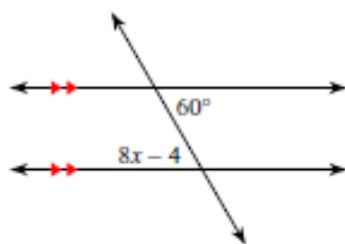
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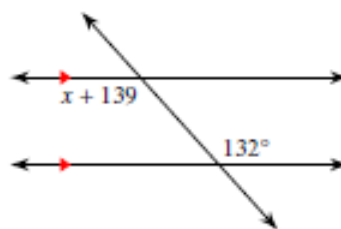
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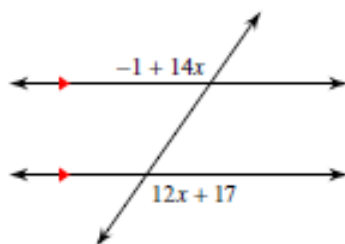
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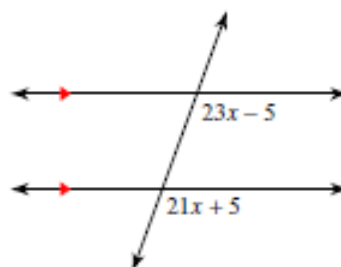
22)



23)

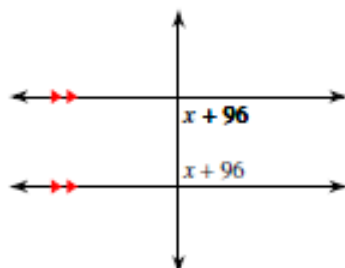


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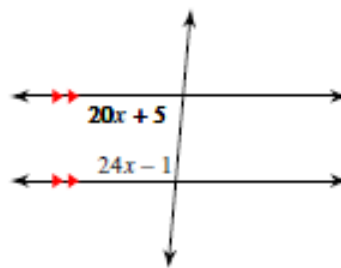


Find the measure of the angle indicated in bold.

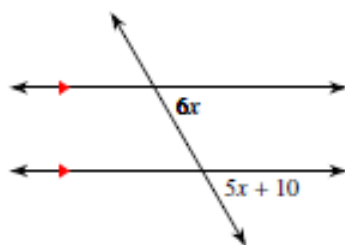
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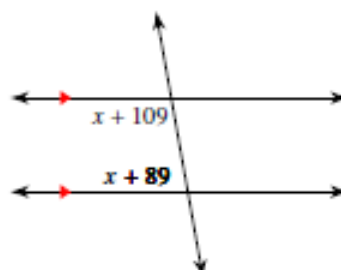
26)



27)



28)



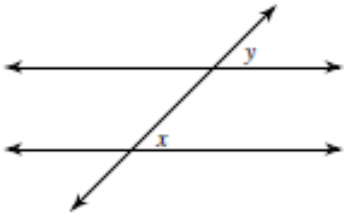
Parallel Lines and Transversals

Date

Period

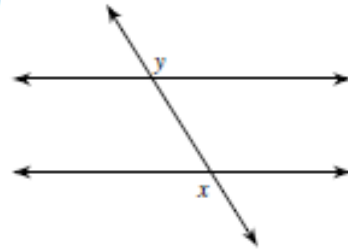
Identify each pair of angles as corresponding, alternate interior, alternate exterior, or consecutive interior.

1)



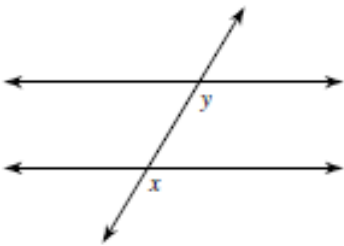
corresponding

2)



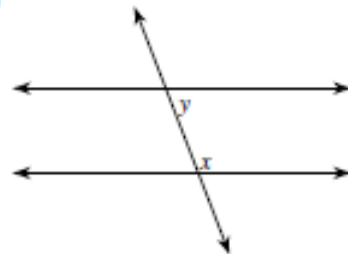
alternate exterior

3)



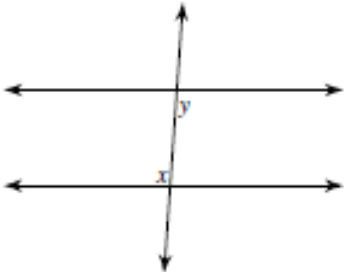
corresponding

4)



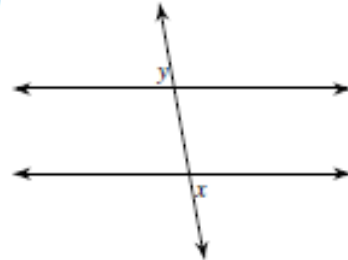
consecutive interior

5)



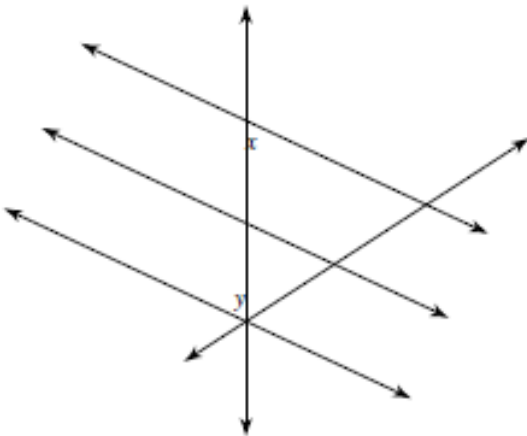
alternate interior

6)



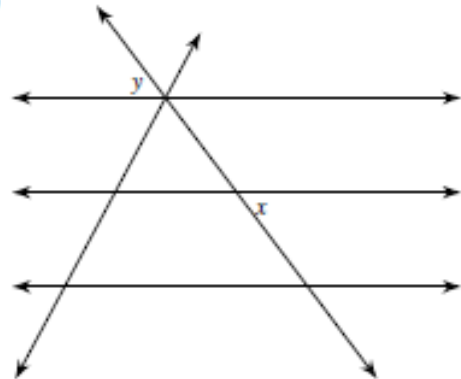
alternate exterior

7)



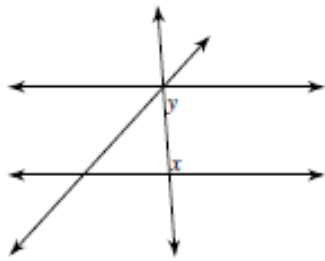
alternate interior

8)



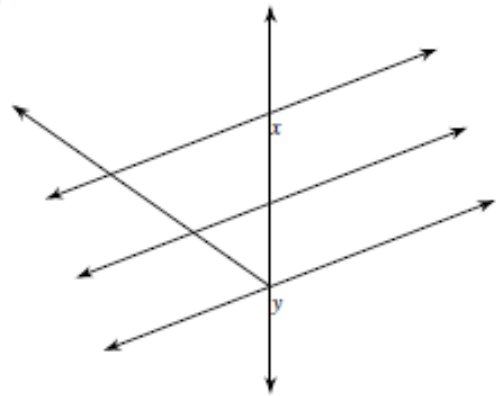
alternate exterior

9)



consecutive interior

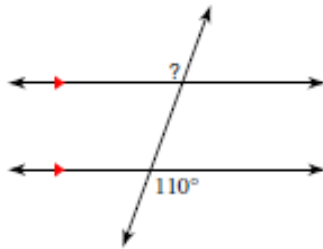
10)



corresponding

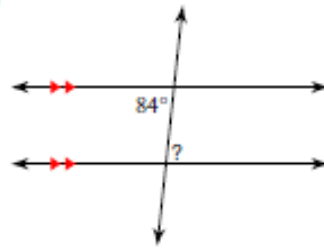
Find the measure of each angle indicated.

11)



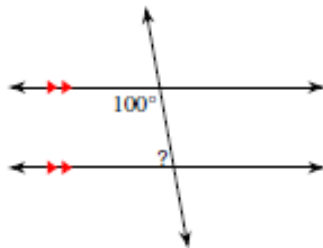
110°

12)



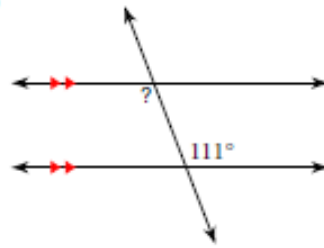
84°

13)



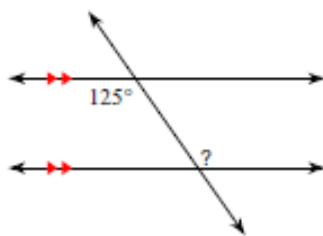
80°

14)



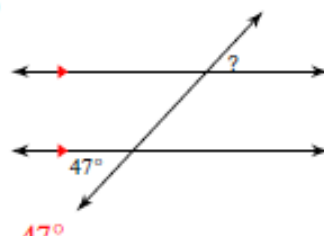
111°

15)



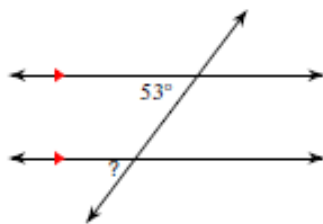
125°

16)



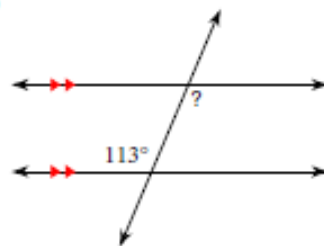
47°

17)



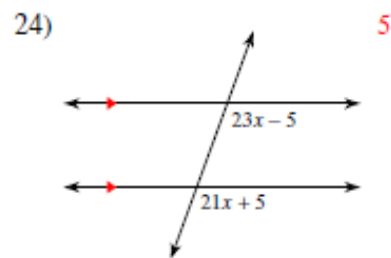
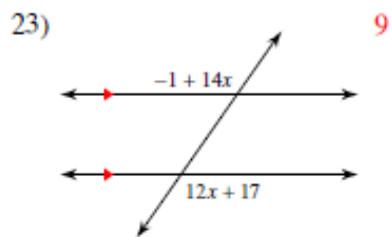
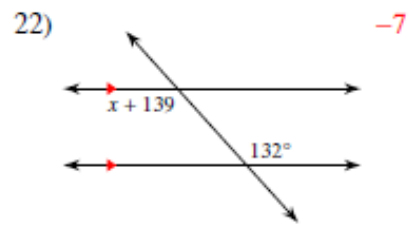
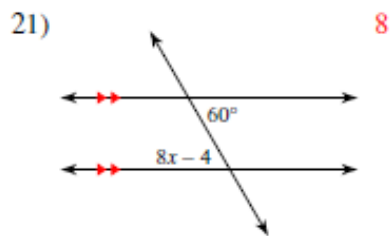
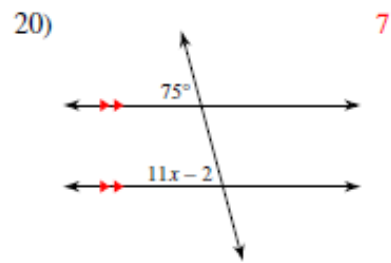
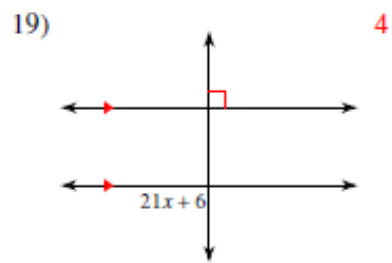
53°

18)



113°

Solve for x .



Find the measure of the angle indicated in bold.

