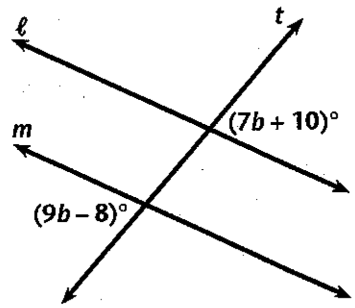
NAME ______________________ CLASS ____________ DATE ____________

Enrichment
3.4 Parallel Lines and Variable Angle Measures

In the figure at right, what value of the variable b guarantees that lines ℓ and m are parallel? Notice that the angles with measures $(9b - 8)°$ and $(7b + 10)°$ are a pair of alternate exterior angles. If these measures are equal, it follows that $\ell \parallel m$. So you can write and solve an equation that reflects this fact.

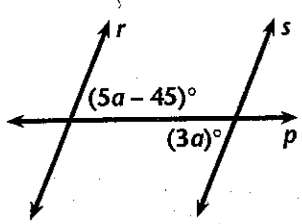


$$9b - 8 = 7b + 10$$
$$9b - 8 + 8 = 7b + 10 + 8$$
$$9b = 7b + 18$$
$$9b - 7b = 7b + 18 - 7b$$
$$2b = 18$$
$$b = 9$$

When $b = 9$, $(9b - 8)° = 73°$ and $(7b + 10)° = 73°$, giving $\ell \parallel m$.

Find the value of a that guarantees $r \parallel s$.

1.



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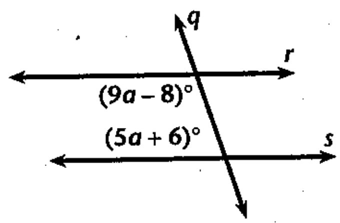
2.



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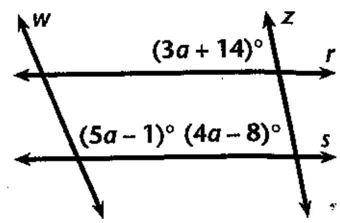
3.



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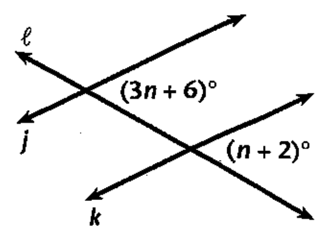
4. Refer to the figure at right. Explain why it is not possible to find a value of n that guarantees $j \parallel k$.



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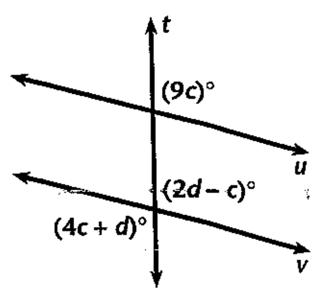
5. **a.** Refer to the figure at right. Explain why $u \parallel v$ for any reasonable values of c and d.

____

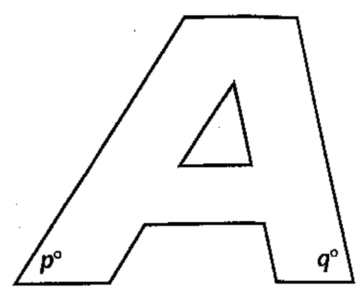
b. Give the range of reasonable values for c and d.

____



6. The diagram at right is a plan for drawing a stylized version of the letter A. A person using this plan may choose any reasonable values for p and q. Enlarge the plan on a separate sheet of paper.

a. Using variable expressions, label the measures of all the acute and obtuse angles. Assume that all segments that appear parallel are, indeed, parallel. (Hint: It will help to extend the segments and to draw at least one additional line.)



b. What is a range of reasonable values for p and q? ______________

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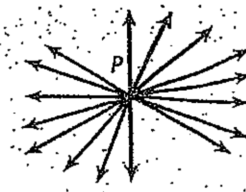
Enrichment
3.8 Pencils of Lines

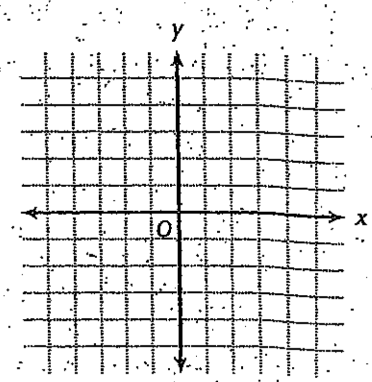
In geometry, a pencil is a set of figures that share a common characteristic. For example, the set of all lines in a plane that pass through one given point in the plane is called a pencil of lines through that point. The point is called the carrier of the pencil. The figure at right is part of a pencil of lines for which point P is the carrier.



Exercises 1–4 refer to the lines on the coordinate plane that have the following equations.

a. $y = x + 2$ **b.** $y = -x + 2$ **c.** $y = 0.5x + 2$ **d.** $y = -2x + 2$ **e.** $y = 2$

1. Graph the lines on the coordinate axes at right.



2. What characteristic of the lines do the coefficients of x represent?

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3. The lines are all part of a pencil of lines on the coordinate plane. What are the coordinates of the carrier? ______________

4. Each equation is of the form $y = mx + 2$, where m is a real number. Explain why this general equation does not define the *entire* pencil of lines through the carrier that you named in Exercise 3.

____

Write general equations to define the entire pencil of lines with each given carrier. Assume that all variables represent real numbers.

5. **a.** $J(0, -5)$ ______ **b.** $K(0, 8)$ ______ **c.** $L(0, b)$ ______

6. **a.** $P(2, 0)$ ______ **b.** $Q(-3, 0)$ ______ **c.** $R(a, 0)$ ______

7. **a.** $S(1, 2)$ ______ **b.** $T(2, -3)$ ______ **c.** $U(c, d)$ ______

The set of all lines in a plane parallel to a given line is called a *pencil of parallels*. Write a general equation or equations to define each pencil of parallels.

8. all lines parallel to $y = mx$ ______

9. all lines parallel to the y-axis ______

10. all lines perpendicular to $y = mx$ ______

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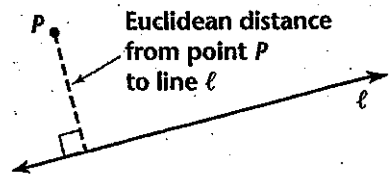
Enrichment

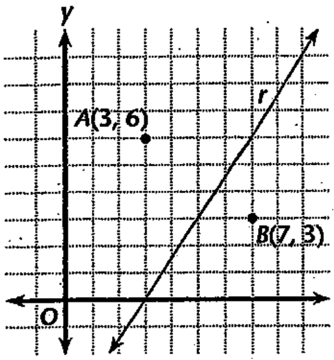
11.2 The Taxidistance from a Point to a Line

The distance from a point to a line is the length of the shortest path between them. You have learned that, in Euclidean geometry, this distance can be simply defined as the length of the perpendicular segment from the point to the line. As you will see, defining the taxidistance from a point to a line is a little more complicated.



Find each taxidistance. (Hint: Look for the shortest path.)

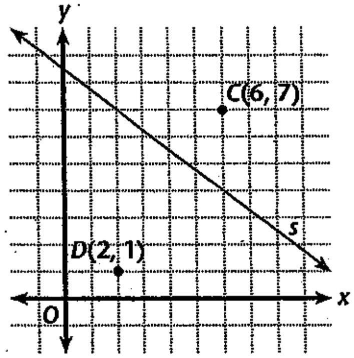
1.



a. from point *A* to line *r* ____________

b. from point *B* to line *r* ____________

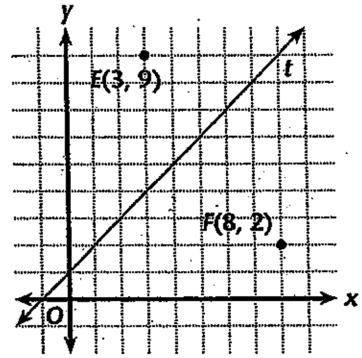
2.



a. from point *C* to line *s* ____________

b. from point *D* to line *s* ____________

3.



a. from point *E* to line *t* ____________

b. from point *F* to line *t* ____________

4. Finding the taxidistance from a point to a line on a coordinate plane depends on the slope, m, of the line. Refer to your work in Exercises 1–3. Explain how to find the taxidistance:

a. when $|m| > 1$. ____________

b. when $|m| < 1$. ____________

c. when $|m| = 1$. ____________

5. Draw a coordinate plane on a separate sheet of paper. Graph the line with equation $y = 2x - 1$.

a. Graph all the points whose taxidistance from the line is four blocks.

b. Graph all the points whose Euclidean distance from the line is four units.

6. Write an algebraic expression for the taxidistance from a point, $P(j, k)$, to a line with equation $y = mx + b$. (Hint: Consider the cases from Exercise 4.)

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