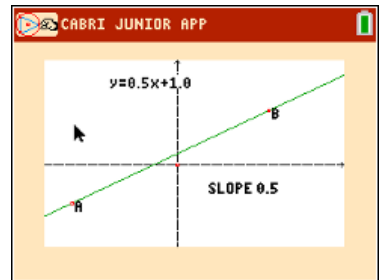




One way to move from point A to point B is by first going in a vertical direction and then horizontally. When points A and B are on the same line, a special relationship exists between the vertical and horizontal moves. In this activity, you will use coordinates to better understand that relationship, as well as the relationship between coordinates of points and their quadrant locations, slopes and y-intercepts, and parallel and perpendicular lines.



Problem 1 – Coordinates of Points

Open the *Cabri™ Jr* application by pressing **apps**. Open a new file (**y =, New**) and make sure the axes are displayed (press **graph, Hide/Show, Axes**). Note, to undo press **F1, Undo**.

Place a point, *P*, in the top right quadrant. Use **F2, Point, Point On**. Press **F5, Alpha-Num** and **enter** to label the points. When finished with a tool press **clear**.

Display the coordinates of the points. Use **F5, Coord & Eq** and move the cursor to a point until the point is flashing. Press **enter** to select that point, then move the cursor to where you want the coordinate to remain and press **enter** again.

To grab a point that is flashing, press **alpha**. To let go of a point press **clear**. This works as Escape.

First, a little review on coordinate location within the four quadrants. Drag point *P* around into different quadrants. Complete the sentences by writing *positive* or *negative*.

1. A point is in Quadrant 1 (top right) when its x-coordinate is _____ and its y-coordinate is _____.
2. A point is in Quadrant 2 (top left) when its x-coordinate is _____ and its y-coordinate is _____.
3. A point is in Quadrant 3 (bottom left) when its x-coordinate is _____ and its y-coordinate is _____.
4. A point is in Quadrant 4 (bottom right) when its x-coordinate is _____ and its y-coordinate is _____.

Problem 2 – Slope Review

Place a second point, *Q*, on your graph in Quadrant 1. Show its coordinates as you did with point *P* in problem 1. Move *P* into Quadrant 3. Use **F2, Line** to draw a line connecting *P* and *Q*.

Suppose you wanted to go from *P* to *Q*, but you could only make a vertical move up or down or a horizontal move right or left.



5. Describe the vertical and horizontal moves you would make to get from point P to point Q .

6.
 - a. Move point P until the vertical path to a horizontal line through Q is up approximately 2 spaces. Describe the horizontal move to get to point Q .

 - b. Move point P until the vertical path to a horizontal line through Q is up approximately 3 spaces. Describe the horizontal move to get to point Q .

 - c. Write down the horizontal move that will correspond to a vertical move of up approximately 6. Move the point to check your answer.

7. Make an educated guess about the relationship between the number of units and the direction from P to Q . Choose some new points for P and Q , and verify your conjecture.

8. Describe what happens when point P is above and to the right of point Q . Try several points for which this is true. Explain if the results support your conjecture.

In a coordinate system, a move up is considered a positive vertical change; a move down is a negative vertical change; a move right is considered a positive horizontal change; a move left is a negative horizontal change.

9. Using correct signs, find the ratio of vertical change to horizontal change for several pairs of points on the line. Explain what you observe about the ratios.

10. Move points P and Q to fill in the missing information in each line of the table below. Explain your reasoning.



	Coordinates of Point P	Coordinates of Point Q	$\frac{\text{Vertical Change}}{\text{Horizontal Change}}$
1	(-8 , -2)	(6 , 5)	$\frac{7}{14}$
2	(-6 ,)	(,)	$\frac{2}{4}$
3	(, 3)	(,)	$\frac{3}{6}$
4	(6 ,)	(,)	$\frac{-6}{-12}$

11. Describe how the information in the table in question 10 relates to your observations in question 9.

12. Suppose points P and Q are on the line but not displayed in the window of the document. If the vertical change from point P to point Q is 50, find the horizontal change. Explain your reasoning.

13. For a different line, the coordinates of point P are $(-3, -4)$, and the ratio of the vertical change to the horizontal change is equivalent to $\frac{2}{3}$. Find the coordinates of another point on the line. Explain how you found your answer.

Problem 3 – Lines, Equations, and Slopes

Using tools from the F5 find the equation and slope of the line PQ . Press **plus** as you hover over a value to display more digits.

Look for relationships between the points, slope, and equation as you change the line by grabbing and dragging point P , and then by grabbing and dragging the line itself.

14. Place a point on the line and label its coordinates under **F5**. Drag the point along the line and record several coordinates of points. Explain how the coordinates relate to the equation of the line.

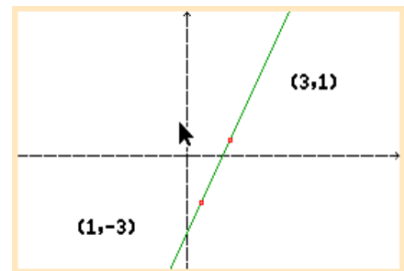


15. When dragging the line by point P , describe the relationship between the points and the slope.

16. When dragging the line by a point, describe the relationship of the slope and the equation.

17. To the right is a graph with two points labeled. Consider the line through these points. Then, consider the graph of the equation $y = \frac{1}{2}x + 2$. Show your work and explain how the two lines compare.

Especially consider the slope and y -intercepts.



Problem 4 – Slopes of Parallel and Perpendicular Lines

Open the Cabri™ Jr. file **PARALLEL**. Drag the lines by points P and Q and examine the slopes.

18. Explain what you notice about the slopes of two parallel lines.

Open the Cabri™ Jr. file **PERPENDI**. Drag the lines to investigate the relationship between the slopes.

19. Explain what you notice about the slopes of two perpendicular lines.

Discuss with a classmate what happens when the slopes of two perpendicular lines are multiplied together. Test your theory on the current slopes of both lines. Now, change the lines by grabbing and dragging point P and test your theory several times.

20. Describe what you observe about the product of the slopes.



Further IB Application

Hannah has always liked the kite shape. She plans to tile her bathroom floor with a pattern made up of kites. For the patter, she will be designing her initial kite $PQRS$ on a set of coordinate axes in which one unit represents 5 cm.

The coordinates of P , Q , and R are $(2, 0)$, $(0, 4)$, and $(4, 6)$ respectively. Point S lies on the x -axis. PR is perpendicular to QS . See the diagram below.

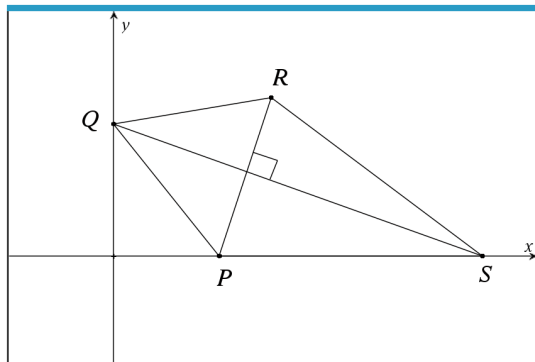


Diagram not to scale.

- (a) Find the gradient of PR .

- (b) Write down the gradient of QS .

- (c) Find the equation of QS and write the answer in the following forms:
 - (i) $y = mx + c$

 - (ii) $y - y_1 = m(x - x_1)$

 - (iii) $ax + by + d = 0$

- (d) Find the coordinates of point S .