Subject: Mathematics

Level: S.2

Topic: Coordinate Geometry of Straight Lines

Sub-topic: Condition for Perpendicular Lines

Background information:
This activity is to be used in the sixth lesson of the topic on Coordinate Geometry of Straight Lines. In the previous sub-topics, students have learnt the slope formula of two given points and the Pythagoras' Theorem.

Learning objective:
1. Content
Students should be able to
investigate the relationship between the slopes of perpendicular lines.

2. Language
Students should be able to
state the condition for two straight lines to be perpendicular to each other using the following sentence pattern:

> *If the two non-vertical straight lines are_____, then the product of their slopes is ....*

> *If the product of the slopes of two non-vertical straight lines is _____, then the straight lines are ....*

> *.................... if and only if ....*

Instructions for teachers
1. The class is divided into 2 groups: the odd-numbered group and the even-numbered group.
2. Students in the odd-numbered group do Part Al. Students in the even-numbered group do Part A2.
3. When they finish the task, they work in pairs, with one from the odd-numbered group and one from the even-numbered group, to check their answers. After discussion, students write down the conclusion in Part B.
4. The teacher then invites 3 students from different pairs to present their findings to the whole class. Other students can comment. The teacher guides students to reach the conclusion that the two non-vertical straight lines are perpendicular to each other if and only if the product of their slopes is -1.
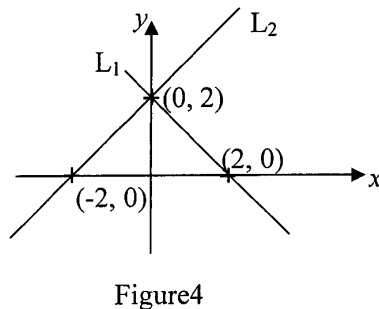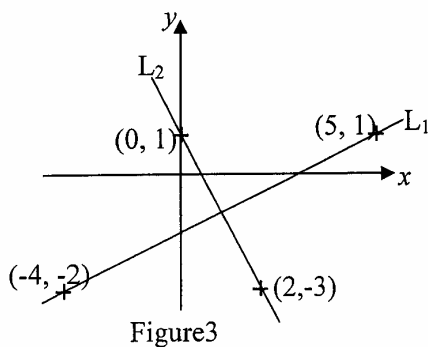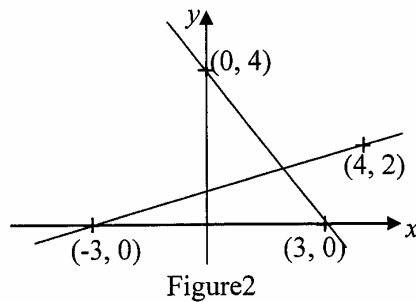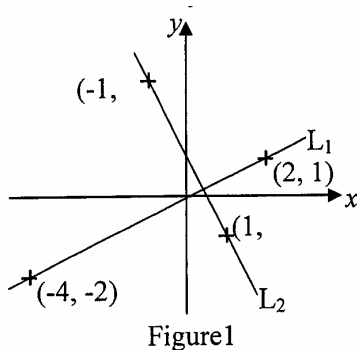
Name:_____No.:_____Class:_____ Date: _____

Slopes of two Perpendicular Lines

Part A1: Each student in the odd-numbered group does this part.

1. Use a protractor to check whether the lines L1 and L2 given below are perpendicular to each other.   Put your answers in the table in Question 2.

Figure1   Figure2

Figure3   Figure4

2. Calculate the slopes of L1 and L2 and their products in the above figures.   Put your answers in the table below.

|	Slope of L_1	Slope of L_2	Product of Slopes **L**	$L_1 \perp L_2$ (Yes/No)
Figure 1				
Figure 2				
Figure 3				
Figure 4				

3. From the table above, what do you think about the relationship between the product of slopes and the perpendicularity of L_1 and L_2?

_____

Part A2: Each student in the even-numbered group does this part.

In Figure 5, P(-2, 0), Q(-4, -2), and R(2, -4) are the vertices of APQR.

1. Determine whether $\triangle PQR$ *is a* right-angled triangle by using the converse of Pythagoras' Theorem.

Figure 5
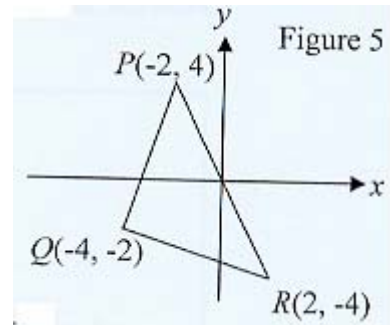
Proof: $PQ^2 =$ _____

$=$ _____

$QR^2 =$ _____

$=$ _____

$PR^2 =$ _____

$=$ _____

$PQ^2 + QR^2 =$ _____ = _____

$\therefore \triangle PQR$ ____ (is/is not) a right-angled triangle with PQ__QR.

(Converse of Pythagoras' Theorem)

2. Using the slope formula, find the slopes *of PQ* and *QR*.
Hence, find the product of slopes *of PQ* and *QR*.

Answer: Slope *of PQ* = _____

Slope of QR = _____

Product of slopes *of PQ and QR* = _____ = _____

3. From the results of Questions 1 and 2, what do you think about the relationship between the product of slopes and the perpendicularity of L_1 and L_2?

_____

Part B:

1. Now, get in pairs, your partner must come from a different group.

2. Tell each other what you have done and let your partner check your answers.

> The following sentences may be useful to you:
> *I think that*..........
>
> *The slope of...in Figure ... is .....*
>
> *The product of the slopes of...... and...... in Figure ... is ......*
> *...... is perpendicular to ......*

3. Correct your answers if necessary,

4. Compare and discuss the results with your partner and make a conclusion about the condition for two non-vertical straight lines to be perpendicular to each other.

5. Write down the conclusion in the following space and be ready to report your answer to the class   "

> The following sentence patterns may be useful to you :
>
> *If the two non-vertical straight lines are_____,   then the product of their slopes is ....*
>
> *If the product of the slopes of two non-vertical straight lines is _____, then the straight lines are ....*
>
>   ....   *if and only if* ....

_____

_____

_____

_____

_____

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