

Teaching and Learning Plan

Distance Formula

Target Students:

Junior Certificate Ordinary & Higher Level Students

Prior Knowledge:

Students should know how to:

- Draw and label x and y axes
- Plot and label points on co ordinate plane
- Calculate the area of a square
- Label vertices and sides of a triangle
- Use a calculator to find squares and square roots of numbers
- Round off numbers to one decimal point

Relationship to Syllabus:

Co ordinate geometry - distance formula

Duration:

Approximately one to three classes

Aims:

The class will take an explorative approach to establish and use the distance formula.

Learning Outcomes:

At the end of using this methodology pupils will be able to:

- Coordinate the plane and plot points
- Measure the length of a line segment using a ruler
- Verify Pythagoras theorem using the student CD
- Calculating side c when given sides a and b (in a right-angled triangle)
- Verify the length of line segment using the formula
- Connect Pythagoras Theorem to the distance formula in coordinate geometry
- Calculate the distance using the formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ for any given points

Resources Required:

Set of mathematical instruments, scientific graph paper, calculator, data projector, computer, student CD.

Also the following files are provided to be used in this Teaching and Learning Plan:

- (1) REVISION WORKSHEET T&L (2) [Exploring Distances](#) (An interactive HTML file)
 (3) Exploring Distance Handout 2 (4) Exploring Distance Homework Assignment

Lesson Interaction is set out under four sub-headings:

i. Student Learning Tasks – Teacher Input:

This section focuses on teacher input and gives details of the key student tasks and teacher questions which move the lesson forward.

ii. **Student Activities** – Possible and Expected Responses: Gives details of possible student reactions and responses and possible misconceptions students may have.

iii. **Teacher's Support and Actions:** Gives details of teacher actions designed to support and scaffold student learning.

iv. **Checking Understanding:** Suggests questions a teacher might ask to evaluate whether the goals/learning outcomes are being/have been achieved. This evaluation will inform and direct the teaching and learning activities of the next class(es).

Student Learning Tasks: Teacher Input	Student Activities: Possible and Expected Responses	Teacher's Support and Actions	Checking Understanding
Teacher needs to review prior knowledge Plotting x y axis Plotting points Correctly labelling a triangle Calculating area of square Rounding off to one decimal place	Incorrectly scaling and labelling x and y axis Plots (y,x) instead of (x,y) Labelling vertices in lower case letters	Distribute REVISION WORKSHEET T&L to the class	Monitor and correct pupil's work on REVISION WORKSHEET T&L
<p>Activity 1: Hand out 1 page of scientific graph paper to each student. NB The units to be used in the x and y axis must be 1cm = 1 unit (i.e. using Scientific paper)</p> <p>(a) Direct students to co-ordinate the plane and plot the points A (2,1) and B (7,5) Using a ruler join A to B Measure the distance AB with the ruler Record the length</p> <p>(b) On a new x y axis, repeat the above procedure at (a) for the points D (2,5) and E (7,1)</p>	Monitor the potential problems as listed above	Ensure that pupils are completing the task successfully and provide scaffolded help. Show correct line segment on board. Some students will only get part (a) completed. However, the work can be differentiated by providing task (b) to some students. Ask students who have plotted points A and B to draw out a separate co-ordinate plane and plot points D and E.	Use a ruler to measure student's line segment

Student Learning Tasks: Teacher Input	Student Activities: Possible and Expected Responses	Teacher's Support and Actions	Checking Understanding
<p>Activity 2</p> <p>(a) Open student Cd and investigate interactive theorem 14, by getting students to add the two smaller squares to verify that it gives the big square. Use the slider to change the sizes of the triangles.</p> <p>(b) Open Students interactive file called "Exploring Distances". (This is a HTML file) Teacher to manipulate and create different right angled triangles. Teacher should hide the value of c until pupils do the calculations. No need to use the words "Pythagoras' Theorem".</p> <p>(c) Distribute " Exploring Distance Handout 2".</p>	<p>The pupils may not associate the distance formula with Pythagoras</p> <p>This handout will reinforce the connection between Pythagoras' theorem and the distance formula. It is not necessary to use the term "Pythagoras' Theorem"</p>	<p>Dynamically change the size of the right angled triangle and get pupils to use the calculator to test is $a^2 + b^2 = c^2$</p> <p>Students must practice numerous examples on calculator before attempting Handout 2.</p> <p>Teacher should check that pupils have at least one correct calculation on the calculator.</p>	<p>Ask pupils to show the areas of the two smaller squares added using their calculator.</p> <p>Pupils must verbalise that this is only associated with right angled triangles.</p> <p>They must successfully calculate c using their calculators.</p> <p>Ask pupils to write down in their own words what the square root of $a^2 + b^2$ gives</p> <p>They must apply this to the Handout 2.</p>

Student Learning Tasks: Teacher Input	Student Activities: Possible and Expected Responses	Teacher's Support and Actions	Checking Understanding
<p>Activity 3 Pupils must now revisit Activity 1. They must do the following, under instruction from the teacher, on the points A and B plotted during Activity 1. Construct a right-angled triangle as follows: The line AB is the hypotenuse</p> <ul style="list-style-type: none"> Drop a line from B parallel to the Y axis Draw a line across from A parallel to the X axis Label the point of intersection, C and write down the co-ordinates of C <p>Find the distance from B to C (i.e. side a) by subtracting the lower Y co-ordinate from the upper Y co-ordinate</p> <p>Find the distance from A to C (i.e. side b) by subtracting the smaller X co-ordinate from the larger X co-ordinate</p> <p>Using the formula from Activity 2, $a^2 + b^2 = c^2$ Substitute in the values for a and b Calculate a value for c Using a ruler, measure the distance from A to B (i.e. c). Verify that the algebraic calculations match the measurement with the ruler.</p>		<p>To generalise: Label the co-ordinates A (x_1, y_1) and the co-ordinates B (x_2, y_2) The distance from A to C (i.e. side b) is equal to $x_2 - x_1$ and the distance from B to C (i.e. side a) is equal to $y_2 - y_1$</p> <ul style="list-style-type: none"> Substitute $b = x_2 - x_1$ and $a = y_2 - y_1$ into $a^2 + b^2 = c^2$ $(y_2 - y_1)^2 + (x_2 - x_1)^2 = c^2$ <p>Find c by getting the square root of both sides</p> $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = c$ <ul style="list-style-type: none"> This is the formula that is used to find the distance between any two points in the plane. <p>The last step may be done very generally with an ordinary level class.</p>	<p>Diagram to be constructed by student.</p> <p>Look out for right angle in triangle.</p> <p>Ask students to explain how they got the sides a and b</p>

Activity 4: Give out handout Exploring Distance Homework Assignment	Does it matter which point you pick first ? Does swapping the x_1 and y_1 with x_2 and y_2 affect the answer ?	Reinforcement activity	May be homework activity.
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REVISION WORKSHEET

The following questions revise:

- Drawing x and y axes and plotting points
- Using the correct mathematical notation to label the vertices and sides of a triangle
- Using a scientific calculator to calculate the square root and square of a number
- Finding the area of a square

Answer the questions in the spaces provided

Q1. Plot the following points on the

A (4,-2),

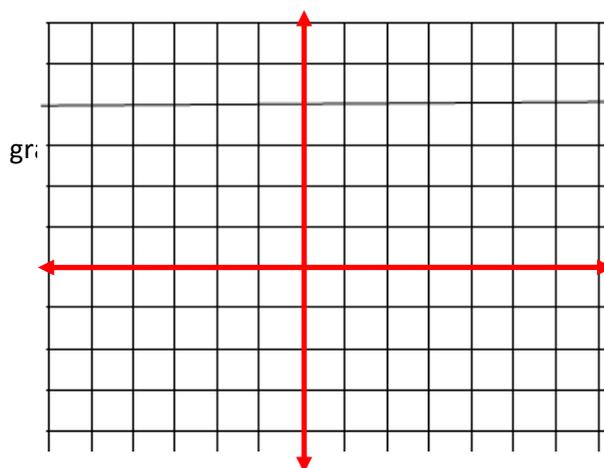
B (-3, 3),

C (2, 0),

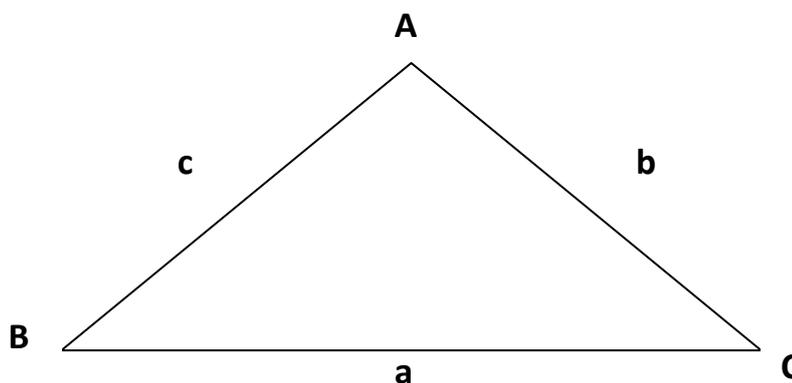
D (-2,-3)

E (0, 3)

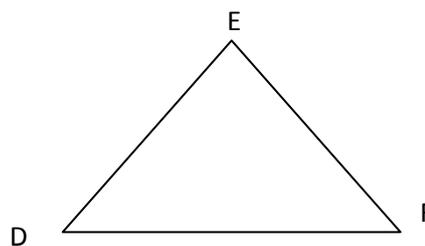
F (1, 1)



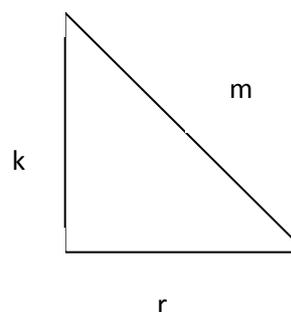
Q2. The diagram below indicates the correct mathematical notation for labelling the vertices and sides of a triangle.



(a) Label the sides of the triangle opposite.



(b) Label the angles of the triangle opposite



Q3. (A scientific calculator may be used to answer the following questions)

(a) Find the square of the following numbers, correct to one decimal place, if necessary..

- (i) 4 (ii) 3.5 (iii) -6.1 (iv) 0.33

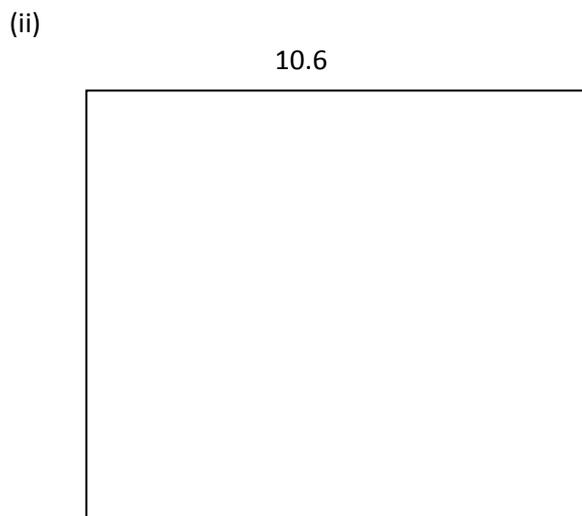
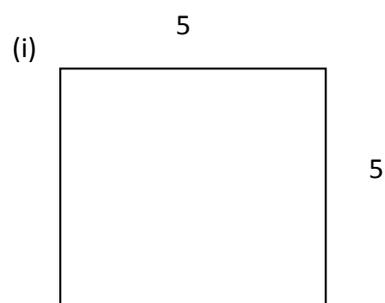
Answer (i) _____ (ii) _____ (iii) _____ (iv) _____

(b) Find the square root of the following numbers, correct to one decimal place.

- (i) 36 (ii) 89 (iii) 105 (iv) 0.5

Answer (i) _____ (ii) _____ (iii) _____ (iv) _____

Q4. Find the area of the following squares, correct to two decimal places.



Answer (i) _____ units²

Answer (ii) _____ units²

Q5. Find the length of the sides of a square of area:

(a) 36 cm² Answer: _____

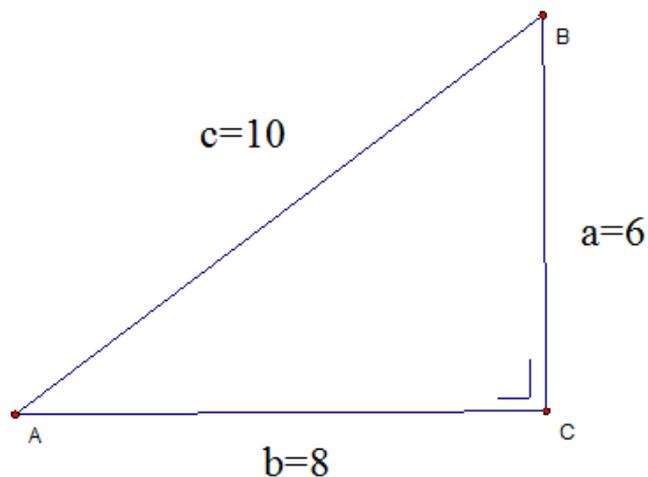
(b) 20.25 m² Answer: _____

Exploring Distance

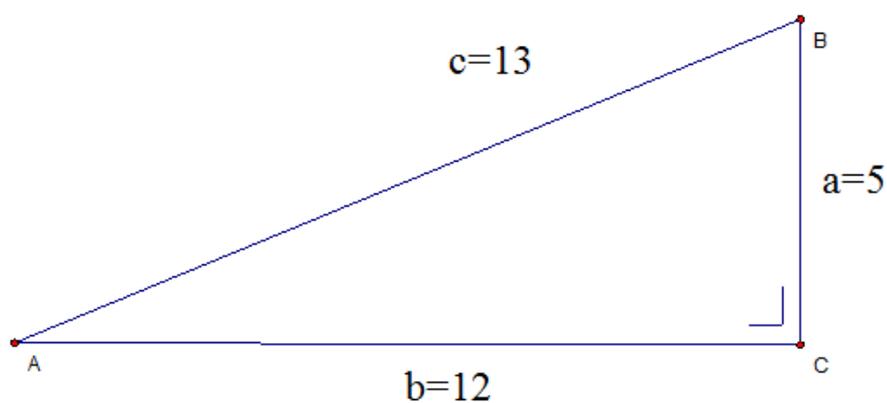
Handout 2.1

The lengths of all 3 sides are given in each triangle below. Use the formula $c = \sqrt{a^2 + b^2}$ and your calculator to show that the longest side marked c in each case is the length indicated. (Show your calculations in the area provided).

Calculations



Calculations

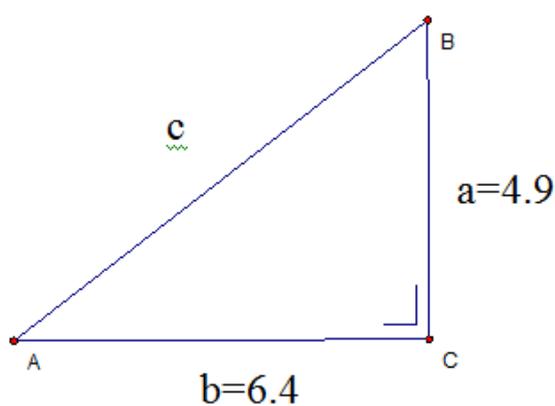


Exploring Distance

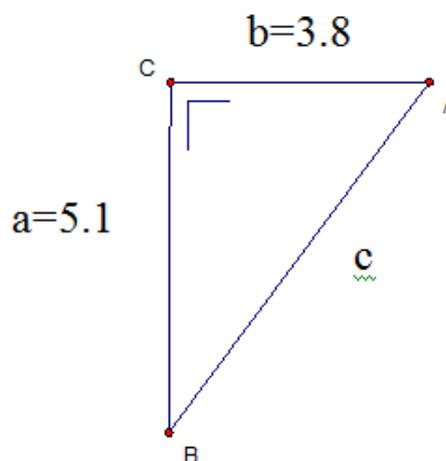
Handout 2.2

The lengths of 2 sides are given in each triangle below. By using the formula $c = \sqrt{a^2 + b^2}$ and your calculator, find the length of the longest side marked c in each case. Show your calculations in the area provided. Check your work by measuring the length of side c with a ruler when you are finished.

Calculations



Calculations

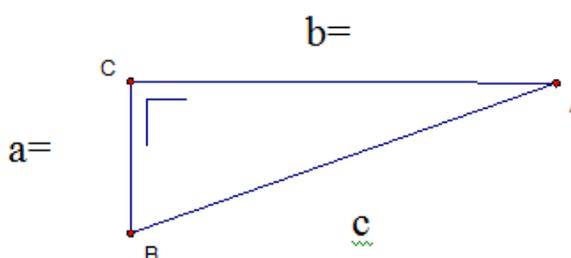


Exploring Distance

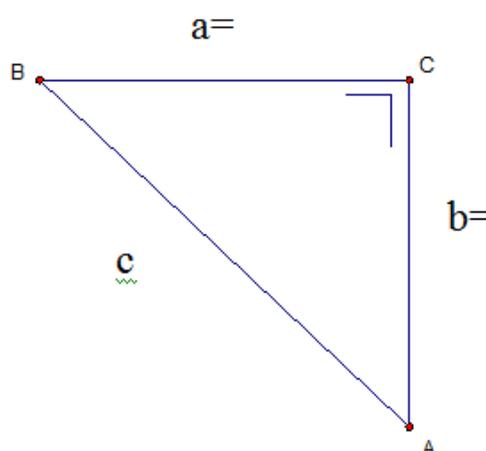
Handout 2.3

The lengths of no sides are given in each triangle below. Measure the lengths of the sides marked **a** and **b** and use the formula $c = \sqrt{a^2 + b^2}$ and your calculator to find the length of the longest side marked **c** in each case. Show your calculations in the area provided. After you are finished check your measurement for side **c** using a ruler.

Calculations



Calculations



Exploring Distance

Homework Assignment

Q1. i) Using the points $A(x_1, y_1)$ and $B(x_2, y_2)$ calculate $|AB|$, the length of AB

using the distance formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

ii) Now using the points $A(x_2, y_2)$ and $B(x_1, y_1)$ calculate $|AB|$, the length of AB

using the distance formula $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Q2. Using the points $C(-3, 6)$ and $D(2, -4)$ calculate $|AB|$, the length of AB

using the distance formula.