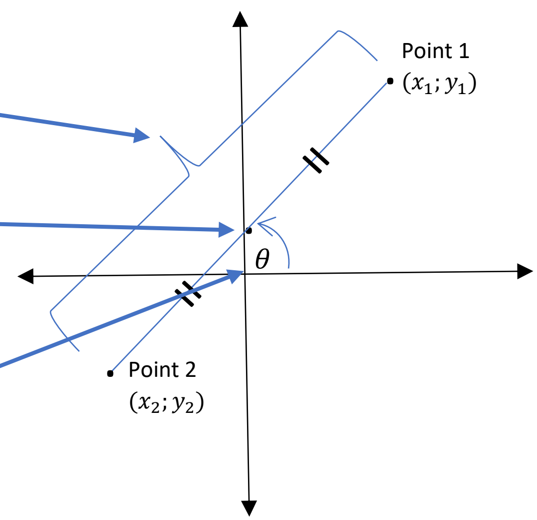
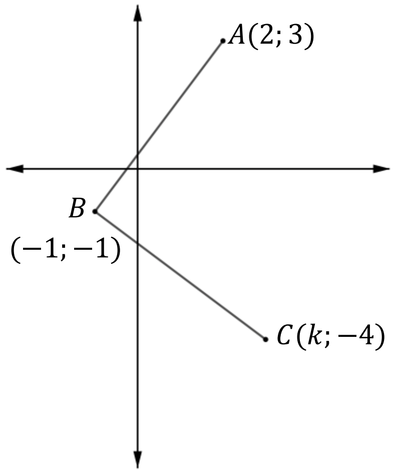
SUBJECT and GRADE	Mathematics– Grade 11	
TERM 2	*Week 1*	
TOPIC	Analytical Geometry: Inclination of Line	
AIMS OF LESSON	Revise Grade 10 content and formulae • Distance between two points • Gradient of a line segment • Midpoint of line segment Introduction to the inclination of a Line Apply these formulae in typical examination type of questions. Highlight the importance of the properties of quadrilaterals	
RESOURCES	***Paper based resources***	***Digital resources***
	Please go to the Analytical Geometry section in your Mathematics Textbook.	https://bit.ly/34mizV https://www.siyavula.com
INTRODUCTION	Let's refresh our knowledge of Grade 10: Distance between two points: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Midpoint of a Line: $Midpoint(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2})$ Gradient of a line: $m = \frac{y_2 - y_1}{x_2 - x_1}$ $m = \tan\theta$ θ Angle of inclination	

CONCEPTS AND SKILLS

Lesson 1A:

In the diagram below $A(2;3), B(-1;-1)$and $C(k;-4)$ are three points in a Cartesian plane.



Remember:

If $l_1 // l_2$ then $m_1 = m_2$

If $l_1 \perp l_2$ then $m_1.m_2 = -1$

Co-linear Points:

The gradients are equal and there must be a common point

Task

1. Calculate the length of AB

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$AB = \sqrt{(-1-2)^2 + (-1-3)^2}$$
$$AB = \sqrt{(-3)^2 + (-4)^2} = \sqrt{25}$$
$$AB = 5$$

2. Calculate the gradient of AB

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$m = \frac{3-(-1)}{2-(-1)} = \frac{4}{3}$$

3. Write down the gradient of BC if AB ⊥ BC.

$$m_{AB} = \frac{4}{3}$$
$$\therefore m_{BC} = -\frac{3}{4}$$

4. Determine the value of k.

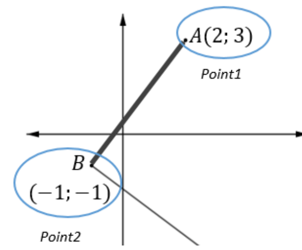
$$m_{BC} = -\frac{3}{4}$$
$$\frac{-1+4}{-1-k} = -\frac{3}{4}$$
$$\frac{3}{-1-k} = -\frac{3}{4}$$
$$3(-1-k) = -12$$
$$-3-3k = -12$$
$$-3k = -9$$
$$\therefore \quad k = 3$$

5. Determine the midpoint of AC.

$$midpnt_{AC}(\frac{x_1+x_2}{2};\frac{y_1+y_2}{2})$$

Important questions you should ask yourself!

1. What? ….length (d).
   - Distance formula – you need 2 points AB
   - Substitute
   - Use calculator to find answer.



2. What? Gradient (m) AB
   - You need 2 points
   - Substitute
   - Simplify

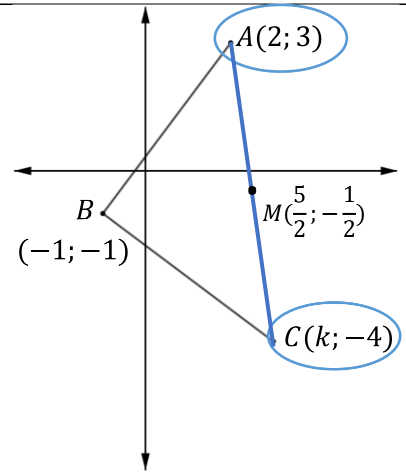
3. What? Gradient
   - You need 2 points but you only have **ONE**
   - **Any other clues?** AB ⊥ BC

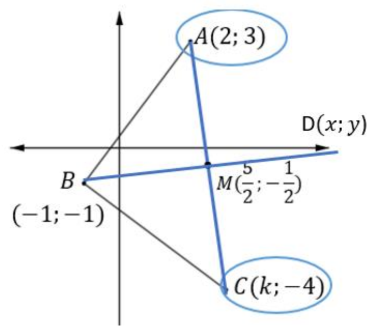
   $\therefore$ $\boldsymbol{m_{AB}.m_{BC} = -1}$

4. What? Value of variable
   - You need an equation
   - What do you know?

     BC? Gradient is known.
   - 2 points B and C

5. What? Midpoint AC
   - Points A and C
   - Point C is now (3;-4)





$$midpnt_{AC}\left(\frac{2+3}{2};\frac{3-4}{2}\right)$$
$$midpnt_{AC}(\frac{5}{2};\frac{-1}{2})$$

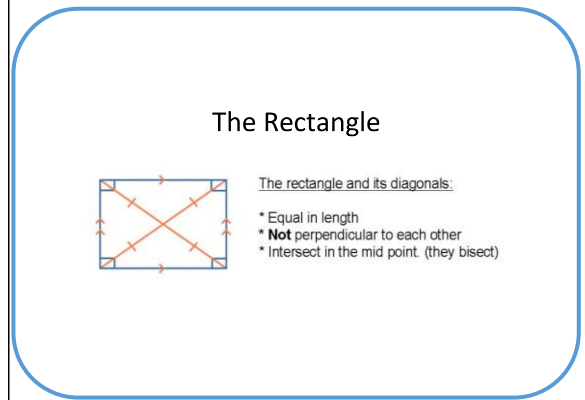
6. Determine the co-ordinates of a point D such that the quadrilateral ABCD is a rectangle.

$$midpnt_{BD}\left(\frac{x_1+x_2}{2};\frac{y_1+y_2}{2}\right)$$
$$midpnt_{BD}(\frac{5}{2};\frac{-1}{2})$$

$$\frac{x-1}{2}=\frac{5}{2} \qquad and \qquad \frac{y-1}{2}=-\frac{1}{2}$$
$$x-1=5 \qquad\qquad y-1=-1$$
$$x=6 \qquad\qquad y=0$$

$$\therefore \; D(6\,;\,0)$$

- Substitute
- Simplify



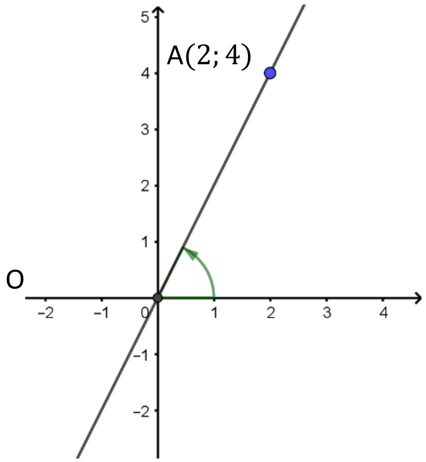
M is therefore the midpoint of both AC and BD if the quadrilateral is a rectangle.
We can thus use the midpoint formula to find the coordinates of D.

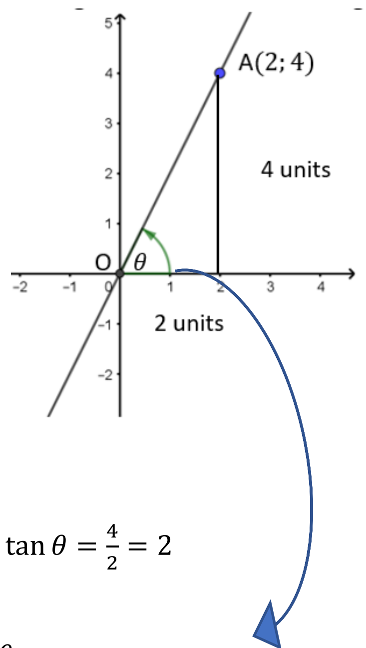
CAN YOU ?

1. C is the point (1 ; -2). The point D lies in the second quadrant and has coordinates $(x; 5)$. If the length of CD is $\sqrt{53}$ units, find the value of x.
   [Solution: $x=-1$]
2. Given the points P$(5;-1)$ and Q$(2;a)$, find a if the gradient of PQ is 2.
   [Solution: $a=\ -7$]

Lesson 1B: The Angle of inclination

Important Notes:	**Examples:**
The angle of inclination is the angle between the positive x −axis and the line.	ACUTE ANGLE / SKERP HOEK





$m = \frac{y_2 - y_1}{x_2 - x_1}$ but we also calculate the $\tan\theta = \frac{4}{2} = 2$

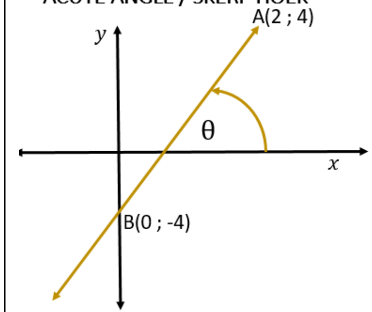
$m_{AO} = \frac{4-0}{2-0}$ $\tan\theta = m$

$m_{AO} = \frac{4}{2} = 2$ $\theta = \tan^{-1} 2 = 63{,}43°$

Therefore we can use $m = \tan\theta$ to determine the ANGLE of INCLINATION
This angle can only be between 0° and 180°.

Examples:

ACUTE ANGLE / SKERP HOEK



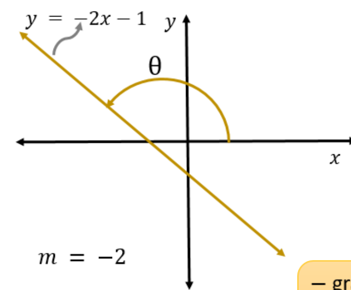
$m = \frac{4-(-4)}{2-0} = 4$

$\tan\theta = 4$

$\theta = 75{,}96°$

+ gradient→
Acute angle/Skerp hoek

OBTUSE ANGLE / STOMP HOEK



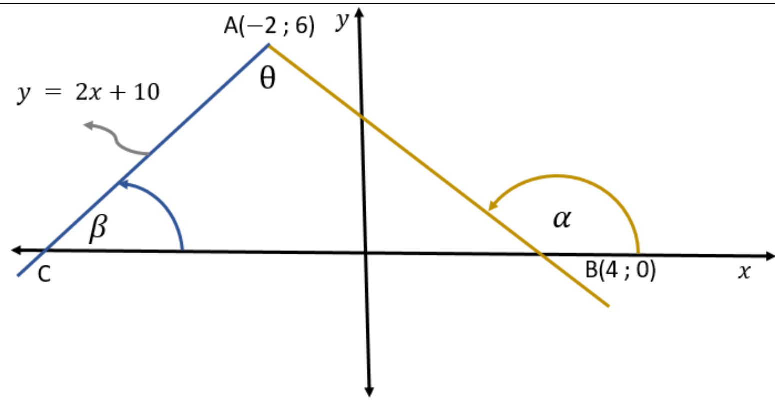
$m = -2$

$\tan\theta = -2$

$\theta = 180° - 63{,}43$ ...

$\theta = 116{,}57°$

− gradient→
Obtuse angle
Stomp hoek



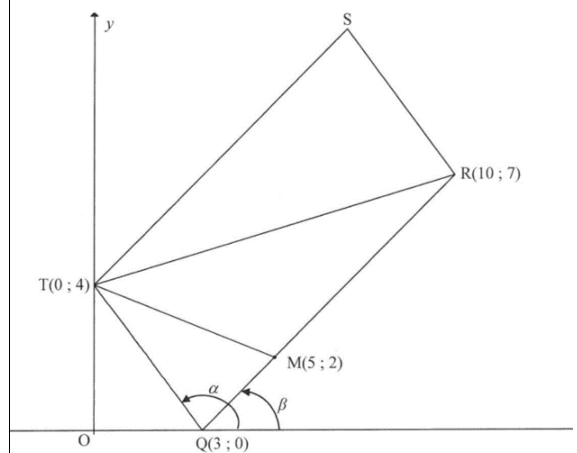
Determine the size of θ

Solution:

$m_{AC} = 2$ $\tan\beta = 2$ $\beta = 63{,}43°$	$m_{AB} = \frac{6-0}{-2-4} = \frac{6}{-6} = -1$ $tan\ \alpha = -1$ $\alpha = 180 - 45° = 135°$	$\theta = \alpha - \beta$ $\theta = 135° - 63{,}43°$ $= 71{,}57°$

Ext angle of a triangle
Or
Interior angles of a triangle can be used

CAN YOU?



Use the diagram to determine:

1. the gradient of TQ $[\boldsymbol{m = -\frac{4}{3}}]$
2. the length of RQ $[\boldsymbol{\sqrt{98} = 7\sqrt{2}}]$
3. F$(k; -8)$ is a point in the Cartesian plane such that T, Q and F are co-linear. Find k. $[\boldsymbol{k = 9}]$
4. the size of $T\hat{Q}R$. $[\boldsymbol{60{,}07°}]$

ACTIVITIES/ASSESSMENT	Mind Action Series	Platinum	Everything Maths Siyavula	Classroom Mathematics
	Ex: 3 &4 Pg: 69 ; 70	***Ex: 2; Pg 66***	Ex: 4 - 6 Pg: 130 - 131	Ex: 4.1 Pg: 84

CONSOLIDATION

- *Read questions carefully and so that you understand what is required and thus select the correct formula.*
- *Take care to ensure correct substitution into the formula.*
- *Make sure you know all the basic properties of quadrilaterals.*