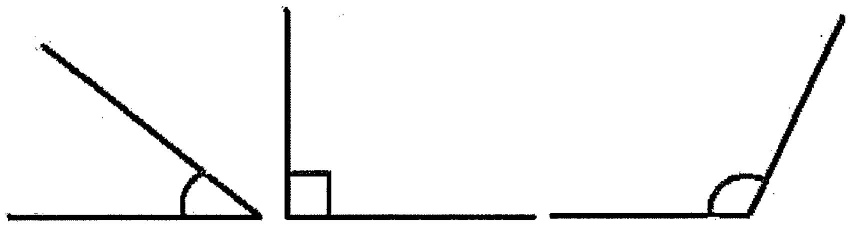
Name: ______________________ Date: ______________

Lesson 1.3 – Obtuse Triangle Investigation

- Learning Goals: Investigate connections between primary trigonometric ratios of acute angles and obtuse angles. Determine the values of the sine ratio, cosine ratio, and tangent ratio for obtuse angles.

Recall

Angles can be divided into three groups based on their measure:



acute less than 90 | right $=90°$ | obtuse more than 90.

Today we will look at sin, cos and tan ratios for obtuse angles. Can we draw a right triangle with one obtuse angle? Explain. NO. Since angles in a triangle add to 180°, if one angle is 90° other two add to 90°.

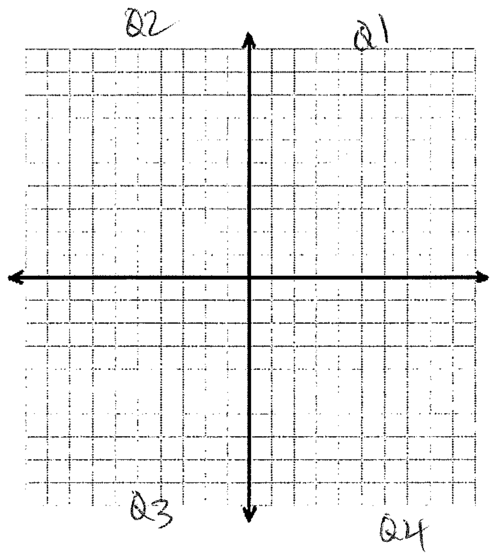
Instead, we use a Cartesian coordinate system to think about trigonometric ratio:

Q1: $0 < \theta < 90$

Q2: $90 < \theta < 180$

Q3: $180 < \theta < 270$

Q4: $270 < \theta < 360$



Two angles are **supplementary** if they add to 180°

Complete the investigation at http://msrouhani.wikispaces.com/file/view/3025%20Obtuse%20Angles.swf

Complete the worksheet as you answer the questions along the way:

Page 2: Copy down the answers in the table (after you move the point D).

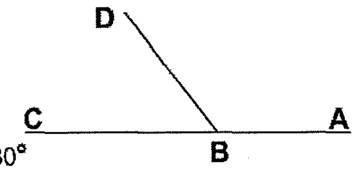
m∠ABD	m∠CBD	m∠ABD+m∠CBD	sin(m∠ABD)	sin(m∠CBD)	cos(m∠ABD)	cos(m∠CBD)	tan(m∠ABD)	tan(m∠CBD)

- What do you notice about the values of sin(∠ABD) and sin(∠CBD)?

- What about the values cos(∠ABD) and cos(∠CBD) or the value of tan(∠ABD) and tan(∠CBD)?

Name: ______________________ Date: ______________

Page 3: After completing the activity, copy the answers below



The angles ABD and CBD are supplementary angles, they add to 180°.
Can you determine the trig ratios of any obtuse angle θ by using supplementary angles?

For example, given that sin 30°= 0.5, cos 30° = 0.866, tan 30° = 0.577, and 150° = 180°- 30°

sin 150° = $\boxed{0.5}$ cos 150° = $\boxed{-0.866}$ tan 150° = $\boxed{-0.577}$

or, given that sin 65°= 0.906, cos 65°= 0.423, and tan 65° = 2.145, and 115° = 180°- 65°

sin 115° = $\boxed{0.906}$ cos 115° = $\boxed{-0.423}$ tan 115° = $\boxed{-2.145}$

In general, for any obtuse angle θ,

sin θ = $\boxed{\text{positive}}$ cos θ = $\boxed{\text{negative}}$ tan θ = $\boxed{\text{negative}}$

$\sin\theta = \sin(180-\theta)$ $\cos\theta = -\cos(180-\theta)$ $\tan\theta = -\tan(180-\theta)$

Page 4: After completing the activity, copy the answers below

Supplementary angles add to $\boxed{180}$.

The angles $\boxed{180-74 = 106°}$ and 74° are examples of supplementary angles.

Given that sin 47° = 0.731, sin $\boxed{180-47 = 133}$ = 0.731.

Given that cos 52° = 0.616, cos 128° = $\boxed{-0.616}$.

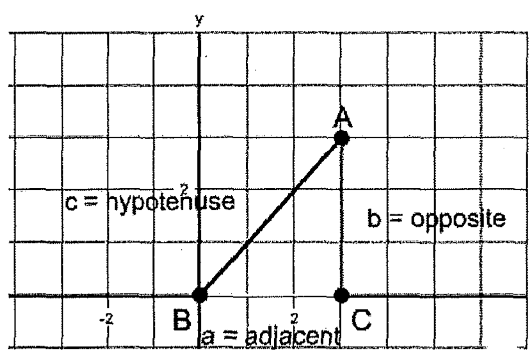
An $\boxed{\text{obtuse}}$ angle is between 90° and 180°.

The trig ratios cosine and $\boxed{\text{tangent}}$ of an obtuse angle is always a negative value.

Given that tan 129° = -1.235, tan 51° = $\boxed{1.235}$.

Given that cos 131° = -0.656, cos $\boxed{180-131 = 49°}$ = 0.656.

Page 5



What are the coordinates of the point A in this graph? (3 , 3)

How do the values of x and y relate to the adjacent and opposite sides of the triangle? x = adjacent side

y = opposite side.

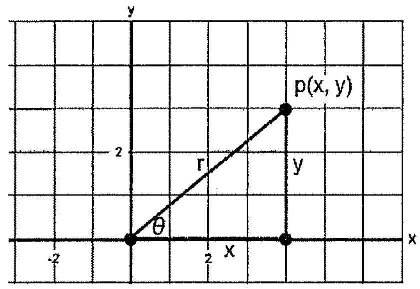
Name: ______________________ Date: ______________

Page 6: Express the trig ratios for the angle θ in terms of x, y, and r

$\sin\theta = \dfrac{\text{opposite}}{\text{hypotenuse}} = \dfrac{\boxed{y}}{\boxed{r}}$

$\cos\theta = \dfrac{\text{adjacent}}{\text{hypotenuse}} = \dfrac{\boxed{x}}{\boxed{r}}$

$\tan\theta = \dfrac{\text{opposite}}{\text{adjacent}} = \dfrac{\boxed{y}}{\boxed{x}}$



Page 7: Drag point P to form acute angles. Drag the point P to form an obtuse angle.

- What do you notice about the three trig ratios? Why does this occur?

'x' co-ordinate will be negative. Hence, $\cos\theta$ and $\tan\theta$ will be negative since $\cos\theta = \frac{x}{r}$ and $\tan\theta = \frac{y}{x}$

Page 8:

Summary

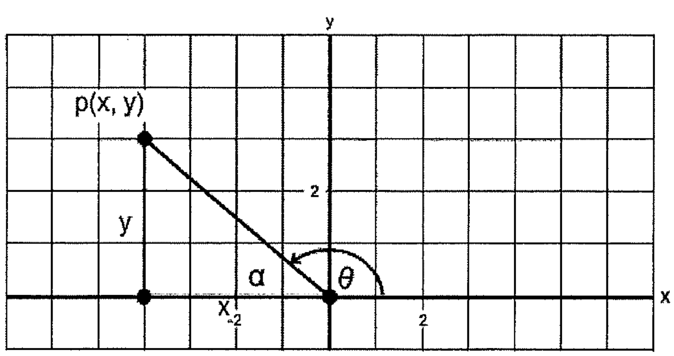
For any angle θ in standard position with the point P(x,y) on the terminal arm, $\sin\theta = \dfrac{y}{r}$, $\cos\theta = \dfrac{x}{r}$, and $\tan\theta = \dfrac{y}{x}$, where $r = \sqrt{x^2 + y^2}$.

The trig ratios of an obtuse angle are the same as the trig ratios of the related acute angle but with opposite signs for cosine and tangent.

$\sin\theta = \sin(180° - \theta)$ $\qquad$ $\cos\theta = -\cos(180° - \theta)$ $\qquad$ $\tan\theta = -\tan(180° - \theta)$

The sine ratio always stays positive for an acute or obtuse angle since y is positive in the first and second quadrants and r, the hypotenuse, is always positive.

The cosine and tangent ratios become negative for an obtuse angle (between 90° and 180°) since x is negative in the second quadrant, which in turn, makes the ratio negative.

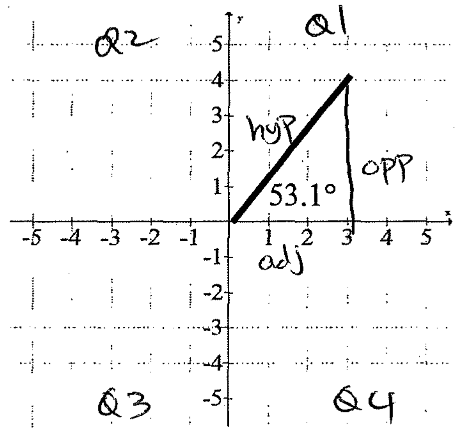


Practice: Continue to complete the rest of the pages in the online activity.

Name: ______________________ Date: ______________

Lesson 1.4 – Trigonometric Ratios for Obtuse Triangles

- Learning Goals: Investigate connections between primary trigonometric ratios of acute angles and obtuse angles. Determine the values of the sine ratio, cosine ratio, and tangent ratio for obtuse angles.



Cartesian coordinate system is divided into **4 quadrants.**

- Label the quadrants on the grid
- Identify the opposite, adjacent and hypotenuse of angle θ
- What is the x-coordinate of point P? 3
  What is the y-coordinate of point P? 4
- Write the 3 trigonometric ratios

$a^2+b^2=c^2$

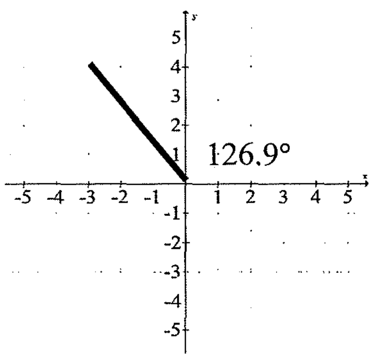
$3^2+4^2=c^2$

$c^2=25$

$c=5$

Sin 53.1 = $\frac{4}{5}$ Cos 53.1 = $\frac{3}{5}$ Tan 53.1 = $\frac{4}{3}$

Notice that the <u>length of the adjacent side is the x-coordinate</u> and the <u>length of the opposite side is the y-coordinate</u>. We can use this idea to find the trigonometric ratios of obtuse angles.



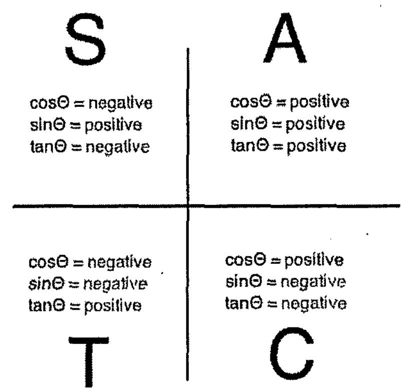
Sin 126.9 = $\frac{4}{5}$ Cos 126.9 = $-\frac{3}{5}$ Tan 126.9 = $-\frac{4}{3}$

In general: Sinθ is positive in Q1 and Q2 cosθ, tanθ is positive in Q1 but they are both negative in Q2

Where are sin, cos and tan positive? This is called the CAST rule:

Notice: For an angle between 0° and 180°,

- If cos or tan are positive the angle is Q1
- If cos or tan are negative the angle is Q2
- If sin is positive the angle could be Q1 or Q2



There are always two angles that could give us the same sin ratio. When finding the angle, we must report **both** possibilities.