Name: Bick, Steffe Due Date: Thursday

Pre-Calculus Topics from Core Plus III Honors Packet #4

Part 1: The Unit Circle

Supplies needed: Graph paper, Ruler, Protractor, Compass, Pencil (absolutely no pen)

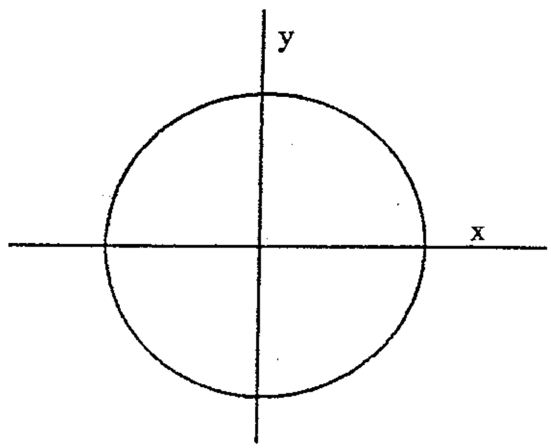
Overview: This activity will help you explore the relationships between sine, cosine, tangent, cotangent, cosecant, and secant. You may computerize (CAD) your unit circles.

Hints:

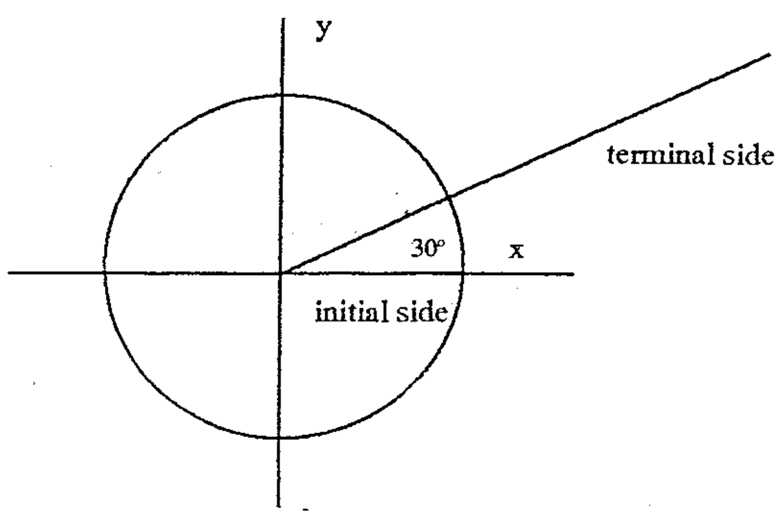
1. Parts A-E, Parts F-G
   - each on a separate sheet of graph paper
   - make circles towards bottom of the page
2. Use ruler, protractor,& compass to make NEAT, clean graphs or you'll be marked down.
3. Write neatly on the packet – do not have scratchwork or scribbles. Do work on a separate piece of paper, if necessary, then transfer neatly to the packet.

Part I. In this part of the Honors Unit you will explore the relationship of **sine** (sin), **cosine** (cos), **tangent** (tan), **cotangent** (cot), **cosecant** (csc), **and secant** (sec).

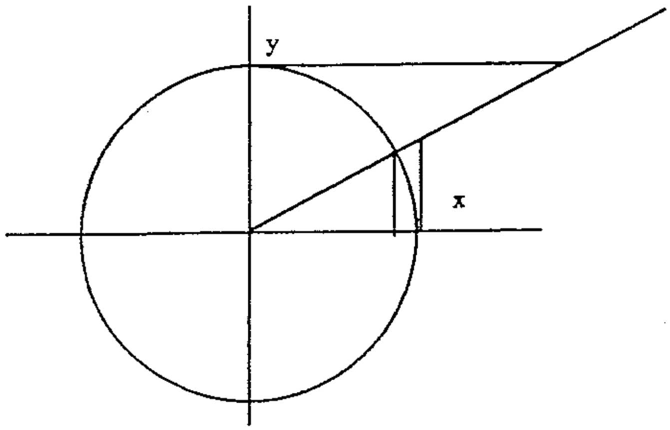
A Using a sheet of graph paper, a compass, a ruler and a protractor, draw a circle with a radius of 10 graph paper squares. Draw a vertical (y) axis and a horizontal (x) axis using the center of the circle as the origin. (see below) We will call this a ***unit circle*** (a circle with a radius of 1 unit).



B Draw a 30° angle in "standard position" with its vertex at the origin and its initial side on the x-axis. (see below)



C * Draw a line segment perpendicular to the x-axis from the point where the terminal side of the angle crosses the circle. *Draw a segment tangent to the circle at (1,0) crossing the terminal side of your angle. *Draw another line segment tangent to the circle at (0,1) crossing the terminal side of your angle. (See below)



D Using your calculator (in **degree mode**) find the values of each of the trig expressions using ~~three decimal places~~ as your approximation.

sin 30° = .500 csc 30° = 2.000

cos 30° = .866 sec 30° = 1.155

tan 30° = .577 cot 30° = 1.732

Fixed

E Find the segments on your graph paper sketch from Part C matching each of the measurements you just found. Remember that 10 graph paper squares = 1 unit so 1 graph paper square would equal 0.1 units or 1/10 of a unit, **label** each segment as the sin 30°, cos 30°, tan 30°, cot 30°, sec 30°, and csc 30°. (Note: the secant and cosecant are the most difficult to find in your picture but they are there.)

F Make a new unit circle on graph paper with the segments drawn as in section **D**. Use a 70° angle and calculate:

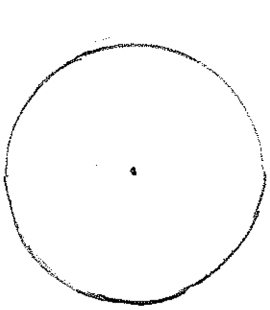
Fixed

sin 70° = .940 csc 70° = 1.064 Fixed.

cos 70° = .342 sec 70° = 2.92

tan 70° = 2.747 cot 70° = .36

Fixed



G Locate the segments on your drawing which match the lengths you just found. **Label** each segment as you did in part **E**.

H Summarize your findings regarding the trig functions and where they can be found on the unit circle. **Before you go any further in this packet check your summary with your current math teacher to make sure what you understand is accurate.**

When using a unit circle,

the sine of an angle. . . . ***is the vertical segment drawn perpendicular to the x-axis from the point where the terminal side of the angle crosses the circle.***

(SAMPLE)

the cosine of an angle . . is the horizontal segment starting at the origin perpendicular to the y-axis from where the 1st vertical side is.

the tangent of an angle . . . Starts at (1,0) Perpendicular to x-axis goes till intersects terminal side of angle.

the cosecant of an angle . . Terminal side of angle till it intersects horizontal line at top of circle

the secant of an angle . . . Terminal angle goes till intersects the Tangent line at (1,0).

the cotangent of an angle . . . Horizontal line starting at (0,1) going till intersect terminal side of the angle.

The representation of each of the trigonometric functions on the unit circle should help you make sense of the values your calculator will give you for the sine, cosine, or tangent of any angle.

Consider your sketch of the 30° angle.

What would happen to the sine of the angle as we increased the angle from 30° to 90°? **THE SINE OF THE ANGLE GETS BIGGER. (SAMPLE)**

What if we decreased the angle from 90° to 0°? The sine of the angle gets smaller

What happens to the sine of the angle as we move from 90° to 180°? Sine gets smaller

Check out these values on your calculator (to the nearest thousandth) and tell why their values make sense on the unit circle.

sin 0° = **0** Why? **BECAUSE THERE IS NO VERTICAL SEGMENT.**

sin 30° = .5 Why? Because half way

sin 50° = .76 Why? between sin 30 and sin 60

sin 90° = 1 Why? its the radius

sin 120° = .86 Why? Between sin 90 and sin 150

sin 150° = .5 Why? Halfway

sin 180° = 0 Why? no vertical Line

What happens to the sine values on your calculator as you increase the value of your angle from 180° to 360°? (Or as move around the circle from 180 to 360 degrees.) They stay the same

Why does this **make sense**? Because your in the negative segment.

Consider the cosine function:

What would happen to the cosine of the angle as we increased the angle from 0° to 90°?

cos θ would get smaller

What if we decreased the angle from 90° to 0°?

cos θ would get Larger

What happens to the cosine of the angle as we move from 90° to 180°?

cos θ decreases to -1

How is this different than the sine function? cos turned negative at 90° rather than 180°

Why is it different? Because it's using a different magazine.

Check out these values on your calculator (to the nearest thousandth) and tell why their values make sense on the unit circle.

cos 0° = 1 Why? Because when at the line of 2π is is (1,0) and cos is = to x

cos 50° = .6427 Why? Between cos 90 and cos 30

cos 90° = 0 Why? there is no horizontal line.

cos 120° = -.500 Why? Between cos90 and cos 135

fixed cos 150° = -.866 Why? Between cos 135 and cos 180

cos 180° = -1 Why? horizontal line going to the left of (0,0) is (-1,0)

What happens to the cosine values on your calculator as you increase the value of your angle from 180° to 360°? (Or as you move around the circle from 180 to 270 degrees?)

Between 180 and 270 they are negative. Between 270 and 360 they are positive.

What happens as you move from 270 to 360 degrees?

Consider the tangent function (refer to your unit circle to find the segment which represents tangent.)

What happens to the tangent of an angle as we move from 0 to 90 degrees? The value increases from 0 to undefined

fixed

What happens at 90°? non-existent asymptotes

What does your calculator say for the tan(90°)? error

Why does that **make sense**? Because $\frac{1}{0}$ is not possible

What does the calculator give you for the following values?

tan 0° = 0

tan 180° = 0

tan 270° = error

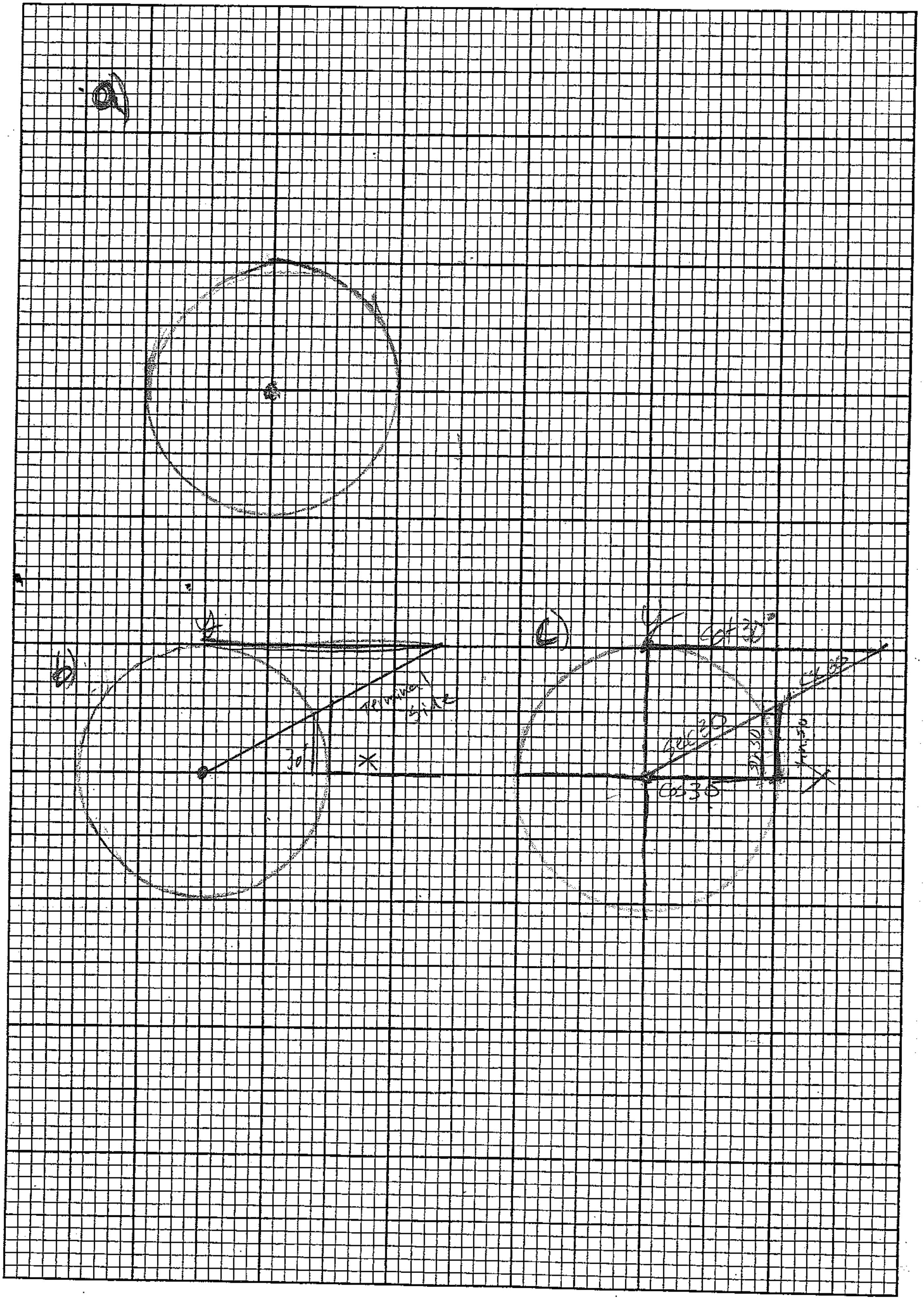
tan 360° = 0

Do these values **make sense**? Why or why not? Yes $\tan\theta = \frac{\sin\theta}{\cos\theta}$

So they make sense.

In this next part of the honors unit on precalculus you will look at exact values of the trigonometric functions for special angles.

You will need to recall some information from the ACT/SAT honors packet regarding the sides of special right triangles. We need to look at 30°/60°/90° triangles and 45° /45° /90° triangles.


a)
b)
Terminal side
30°
c)
cot 30
csc 30
sec 30
cos 30

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