Name: ______________________

Precalculus

Trigonometric Functions

4, 5. N = Worksheets Formulas

I. AMC (Merrill) Practice Worksheets
II. FMC (Connally) Exercises & Problems
III. PTCA (Foerster) Explorations
IV. } N Other Worksheets
V. Formulas and notes

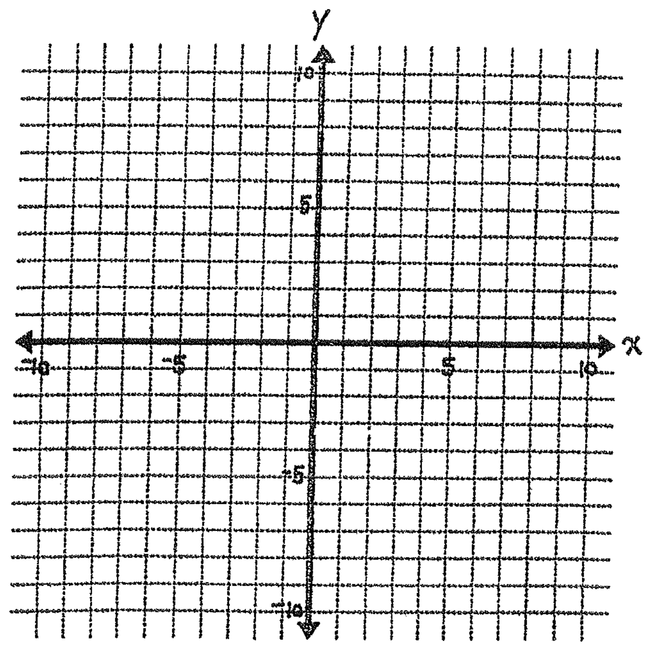
v. 2.0 2007-2008

Name:____________________

Sketching Angles, Circles and Arcs

1. Sketch the rays of the angle 30° in the standard position of a coordinate system.

4. Sketch a circle of radius 8 units in the coordinate system, centered at (0, 0).

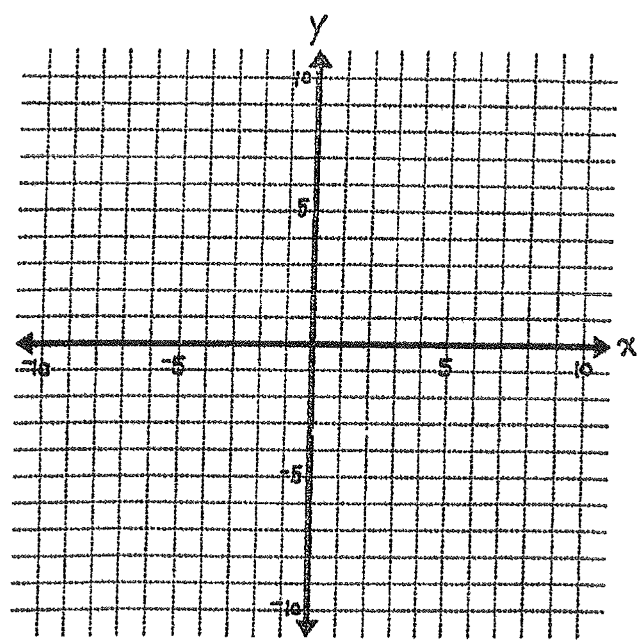


Circumference =   Area =

2. Sketch the angle 135° (as in question 1).

3. Sketch the angle $\frac{10\pi}{6}$ (as in question 1).

5. Sketch the sector with radius 6 units, centered at (0, 0) with central angle 60°.



Extra sketching space above

Arc Length =   Area =
Total Perimeter=
Values of (x, y) at top corner=

NID.

ANGLE DEFINITIONS

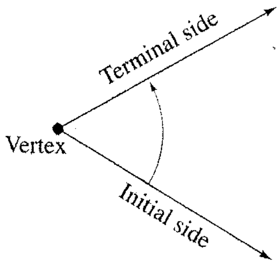


Figure 4.1

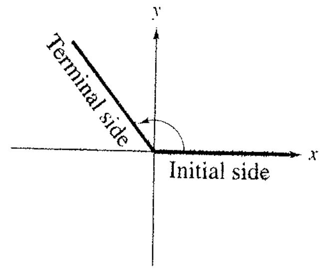


Figure 4.2

An **angle** is determined by rotating a ray (half-line) about its endpoint. The starting position of the ray is the **initial side** of the angle, and the position after rotation is the **terminal side,** as shown in Figure 4.1. The endpoint of the ray is the **vertex** of the angle. This perception of an angle fits a coordinate system in which the origin is the vertex and the initial side coincides with the positive x-axis. Such an angle is in **standard position,** as shown in Figure 4.2. **Positive angles** are generated by counterclockwise rotation, and **negative angles** by clockwise rotation, as shown in Figure 4.3. Angles are labeled with Greek letters such as α (alpha), β (beta), and θ (theta), as well as uppercase letters such as A, B, and C. In Figure 4.4, note that angles α and β have the same initial and terminal sides. Such angles are **coterminal.**

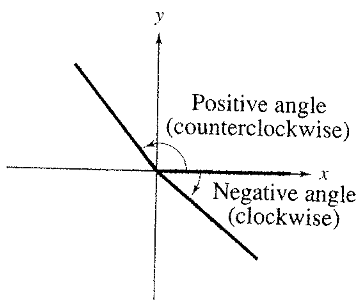


Figure 4.3

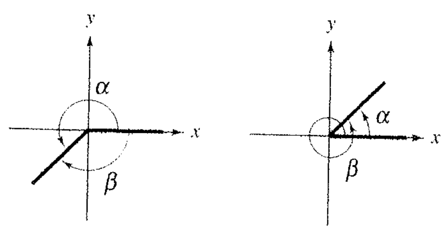


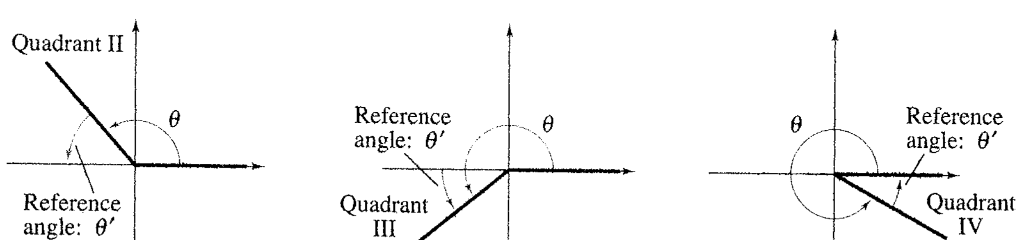
Figure 4.4

Reference Angles

The values of the trigonometric functions of angles greater than 90° (or less than 0°) can be determined from their values at corresponding acute angles called **reference angles.**

> **Definition of Reference Angle**
>
> Let θ be an angle in standard position. Its **reference angle** is the acute angle θ' formed by the terminal side of θ and the horizontal axis.

Figure 4.35 shows the reference angles for θ in Quadrants II, III, and IV.



$\theta' = \pi - \theta$ (radians)
$\theta' = 180° - \theta$ (degrees)

$\theta' = \theta - \pi$ (radians)
$\theta' = \theta - 180°$ (degrees)

$\theta' = 2\pi - \theta$ (radians)
$\theta' = 360° - \theta$ (degrees)

Figure 4.35

N20.

Radians and Degrees

1 radian (rad) $= \dfrac{180°}{\pi}$

radians are "unit-free" numbers.

1 degree (deg or °) $= \dfrac{\pi}{180}$ rad

For θ_{deg} in degrees & θ_{rad} in radians:

$$\theta_{rad} = \frac{\pi}{180°} \cdot \theta_{deg}$$

$$\theta_{deg} = \frac{180°}{\pi} \cdot \theta_{rad}.$$

Arc Length spanned in a circle:

$s = r\theta$, where θ is in radians.

Area of a sector, given central angle and radius of a circle

$A = \frac{1}{2} r^2 \theta$, where θ is in radians.

Coterminal angles

If θ_{deg} is the degree measure of an angle, then all angles of the form

$$\theta_{deg} + 360° \cdot k,$$

where k is an integer, are coterminal with θ_{deg}.

For θ_{rad} in radians, the same holds for

$$\theta_{rad} + 2k\pi.$$

NAME: ______________

DIVIDING FRACTIONS AND SQUARE ROOTS

1. Rule: $\dfrac{\frac{a}{b}}{\frac{c}{d}} = \left(\frac{a}{b}\right)\left(\frac{d}{c}\right) = \frac{ad}{bc}$. Example: $\dfrac{\left(\frac{3}{5}\right)}{\left(\frac{7}{11}\right)} = \frac{3}{5}\cdot\frac{11}{7} = \frac{33}{35}$.

a) $\dfrac{\frac{4}{3}}{\frac{6}{8}} =$

b) $\dfrac{2}{\frac{11}{17}} =$

c) $\dfrac{1}{\left(\frac{1}{2}\right)} =$

d) $\dfrac{1}{\left(\frac{4}{3}\right)} =$

2. Rule: Simplify $\frac{1}{\sqrt{a}}$ by multiplying by $\frac{\sqrt{a}}{\sqrt{a}}$, $\frac{1}{\sqrt{a}} = \frac{1\cdot\sqrt{a}}{\sqrt{a}\sqrt{a}} = \frac{\sqrt{a}}{a}$.

Example: $\frac{1}{\sqrt{11}} = \frac{1\cdot\sqrt{11}}{\sqrt{11}\cdot\sqrt{11}} = \frac{\sqrt{11}}{11}$.

a) $\frac{1}{\sqrt{2}} =$

b) $\frac{1}{\sqrt{3}} =$

c) $\frac{2}{\sqrt{3}} =$

d) $\dfrac{1}{\left(\frac{2}{\sqrt{3}}\right)} =$

e) $\sqrt{\frac{1}{10}} =$

f) $\sqrt{\frac{3}{4}} =$

g) $\sqrt{\frac{4}{3}} =$

h) $\dfrac{\frac{15}{17}}{\sqrt{\frac{15}{17}}} =$

N40.

Worksheet 6.3: The Unit Circle

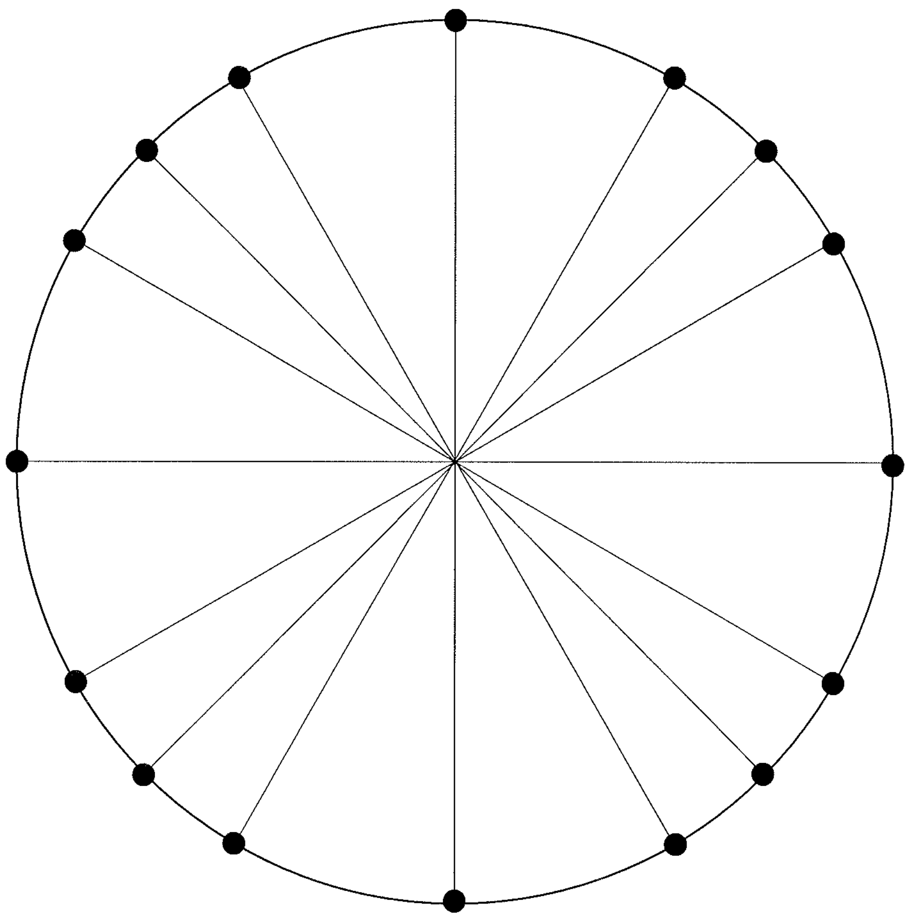


Figure 11

θ	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	π
θ	$0°$	$30°$	$45°$	$60°$	$90°$	$120°$	$135°$	$150°$	$180°$
$\cos\theta$									
$\sin\theta$									
θ	$\frac{7\pi}{6}$	$\frac{5\pi}{4}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	$\frac{5\pi}{3}$	$\frac{7\pi}{4}$	$\frac{11\pi}{6}$	2π	
θ	$210°$	$225°$	$240°$	$270°$	$300°$	$315°$	$330°$	$360°$	
$\cos\theta$									
$\sin\theta$									

N50.

DMS NOTATION

DEG	MIN	SEC
DEGREE	MINUTE	SECOND
1°	$1' = \frac{1}{60}^\circ$	$1'' = \frac{1}{3600}^\circ = \frac{1}{60}'$

TI-83

Use Degree Mode (NOT RADIAN)

$\boxed{\text{MODE}}$ Degree (3rd line)

- Decimal → DMS

13.67 $\boxed{\text{2nd}}$ $\boxed{\text{Angle}}$ 4: ▶DMS $\boxed{\text{ENTER}}$

$13^\circ 40' 12''$

- DMS → Decimal

13 $\boxed{\text{ANGLE}}$ $\boxed{1:{}^\circ}$ 40 $\boxed{\text{ANGLE}}$ $\boxed{2:{}'}$ 12 $\boxed{\text{ALPHA}}$ $\boxed{''}$ $\boxed{\text{ENTER}}$

13.67

degree $^\circ$ = $\boxed{\text{ANGLE}}$ 1: $^\circ$

minute $'$ = $\boxed{\text{ANGLE}}$ 2: $'$

second $''$ = $\boxed{\text{ALPHA}}$ $\boxed{''}$

- TO FORCE DECIMAL (IN CASE STUCK IN DMS)

$\boxed{\text{MATH}}$ $\boxed{\text{2: ▶Dec}}$

13.67

N60.

$\boxed{6.5}$ PRINCIPAL VALUES OF INVERSE TRIG. FUNCTIONS

$\boxed{6.4}$ Inv. trig.

PRINCIPAL VALUES.

See also: AMC p.334 | Foerster p.161 | Finney p.161

One-to-one = useful for inverting.

ONE-TO-ONE FUNCTION	PARENT FUNCTION	RESTRICTED DOMAINS = PRINCIPAL VALUES
Sin x	sin x	$-90^\circ \le x \le 90^\circ$
Cos x	cos x	$0^\circ \le x \le 180^\circ$
Tan x	tan x	$-90^\circ < x < 90^\circ$
Csc x	csc x	$-90^\circ \le x \le 90^\circ$ and $x \ne 0^\circ$
Sec x	sec x	$0^\circ \le x \le 180^\circ$ and $x \ne 90^\circ$
Cot x	cot x	$0 < x < 180^\circ$

COT/TAN DIFFERENT

NOTE: CAPITAL LETTERS ONLY USED IN AMC BOOK

These are not functions: $\sin^{-1}x$, arcsin x, $\cos^{-1}x$, ... etc.

These are functions: $\text{Sin}^{-1}x$, Arcsin x, $\text{Cos}^{-1}x$, ... etc.

Calculator uses Restricted Domains.

$\text{Sin}^{-1}x$: $\boxed{\text{SIN}^{-1}}$

$\text{Cos}^{-1}x$: $\boxed{\text{COS}^{-1}}$

$\text{Tan}^{-1}x$: $\boxed{\text{TAN}^{-1}}$

CALCULATOR CONVERSIONS

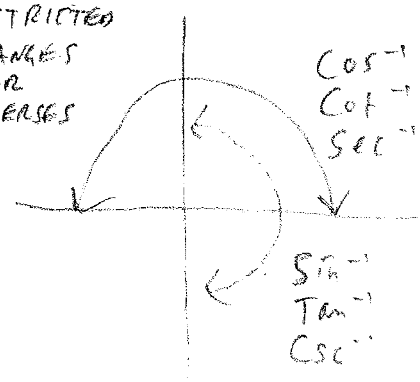
$\text{Csc}^{-1}x = \text{Sin}^{-1}(1/x)$

$\text{Sec}^{-1}x = \text{Cos}^{-1}(1/x)$

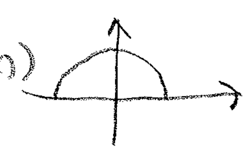
$\text{Cot}^{-1}x = 90^\circ - \text{Tan}^{-1}(x) = \frac{\pi}{2} - \text{Tan}^{-1}$

(NOTE DIFFERENCE IN COT/TAN)

RESTRICTED RANGES FOR INVERSES



FUN PLOT: $y = \text{Sin}(\text{Cos}^{-1}(x))$



$\boxed{7\text{-}4}$ HALF ANGLE FORMULAS p. 379.

$$\cos 2\theta = 2\cos^2\theta - 1$$

Let $\alpha = 2\theta$

$$\cos\alpha = 2\cos^2\left(\frac{\alpha}{2}\right) - 1$$

$$\boxed{\begin{aligned} \cos\left(\frac{\alpha}{2}\right) &= \pm\sqrt{\frac{1+\cos\alpha}{2}} \\ \sin\left(\frac{\alpha}{2}\right) &= \pm\sqrt{\frac{1-\cos\alpha}{2}} \\ \tan\left(\frac{\alpha}{2}\right) &= \pm\sqrt{\frac{1-\cos\alpha}{1+\cos\alpha}} \\ &\qquad (\cos\alpha \neq -1) \end{aligned}}$$

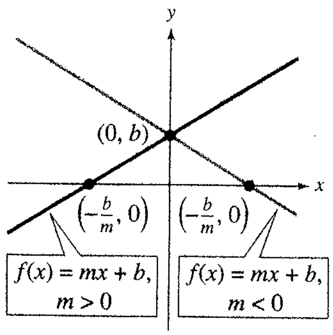
N 80.

N8

LIBRARY OF FUNCTIONS SUMMARY

Linear Function

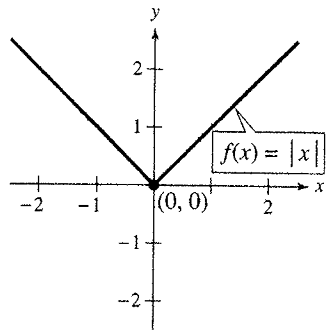
$f(x) = mx + b$



Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$
x-intercept: $(-b/m, 0)$
y-intercept: $(0, b)$
Increasing when $m > 0$
Decreasing when $m < 0$

Absolute Value Function

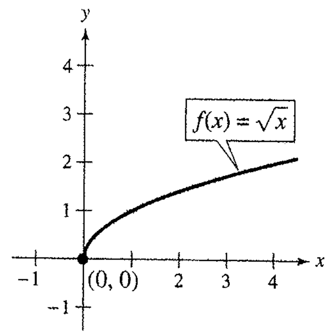
$$f(x) = |x| = \begin{cases} x, & x \geq 0 \\ -x, & x < 0 \end{cases}$$



Domain: $(-\infty, \infty)$
Range: $[0, \infty)$
Intercept: $(0, 0)$
Decreasing on $(-\infty, 0)$
Increasing on $(0, \infty)$
Even function
y-axis symmetry

Square Root Function

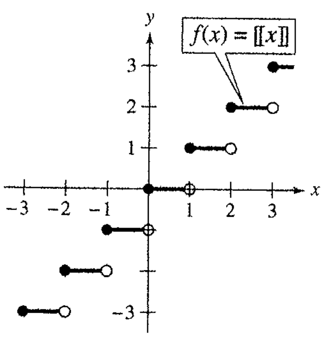
$f(x) = \sqrt{x}$



Domain: $[0, \infty)$
Range: $[0, \infty)$
Intercept: $(0, 0)$
Increasing on $(0, \infty)$

Greatest Integer Function

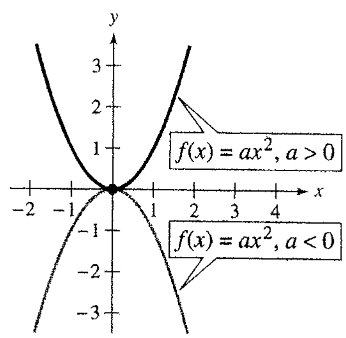
$f(x) = [\![x]\!]$



Domain: $(-\infty, \infty)$
Range: the set of integers
x-intercepts: in the interval $[0, 1)$
y-intercept: $(0, 0)$
Constant between each pair of consecutive integers
Jumps vertically one unit at each integer value

Quadratic (Squaring) Function

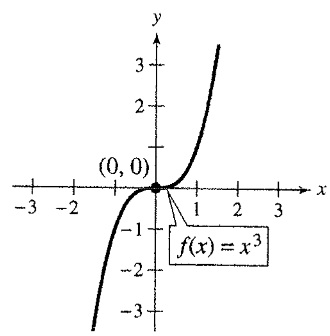
$f(x) = ax^2$



Domain: $(-\infty, \infty)$
Range $(a > 0)$: $[0, \infty)$
Range $(a < 0)$: $(-\infty, 0]$
Intercept: $(0, 0)$
Decreasing on $(-\infty, 0)$ for $a > 0$
Increasing on $(0, \infty)$ for $a > 0$
Increasing on $(-\infty, 0)$ for $a < 0$
Decreasing on $(0, \infty)$ for $a < 0$
Even function
y-axis symmetry
Relative minimum $(a > 0)$, relative maximum $(a < 0)$, or vertex: $(0, 0)$

Cubic Function

$f(x) = x^3$

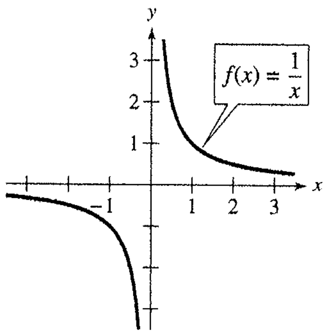


Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$
Intercept: $(0, 0)$
Increasing on $(-\infty, \infty)$
Odd function
Origin symmetry

N90.

Rational (Reciprocal) Function

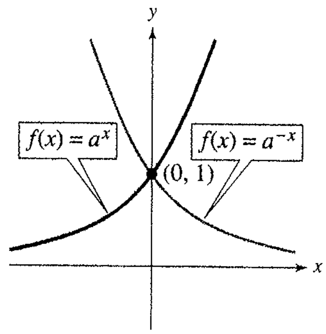
$f(x) = \dfrac{1}{x}$



Domain: $(-\infty, 0) \cup (0, \infty)$
Range: $(-\infty, 0) \cup (0, \infty)$
No intercepts
Decreasing on $(-\infty, 0)$ and $(0, \infty)$
Odd function
Origin symmetry
Vertical asymptote: y-axis
Horizontal asymptote: x-axis

Exponential Function

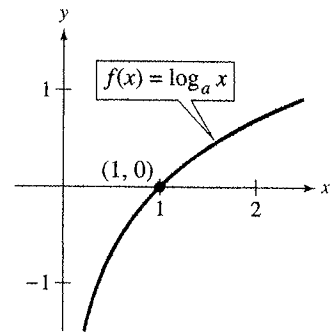
$f(x) = a^x,\ a > 0,\ a \neq 1$



Domain: $(-\infty, \infty)$
Range: $(0, \infty)$
Intercept: $(0, 1)$
Increasing on $(-\infty, \infty)$
for $f(x) = a^x$
Decreasing on $(-\infty, \infty)$
for $f(x) = a^{-x}$
x-axis is a horizontal asymptote
Continuous

Logarithmic Function

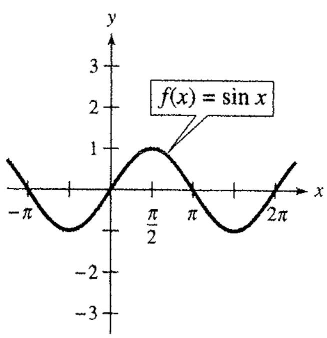
$f(x) = \log_a x,\ a > 0,\ a \neq 1$



Domain: $(0, \infty)$
Range: $(-\infty, \infty)$
Intercept: $(1, 0)$
Increasing on $(0, \infty)$
y-axis is a vertical asymptote
Continuous
Reflection of graph of $f(x) = a^x$
in the line $y = x$

Sine Function

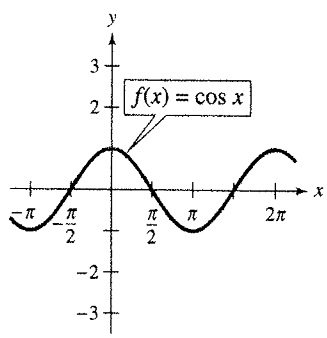
$f(x) = \sin x$



Domain: $(-\infty, \infty)$
Range: $[-1, 1]$
Period: 2π
x-intercepts: $(n\pi, 0)$
y-intercept: $(0, 0)$
Odd function
Origin symmetry

Cosine Function

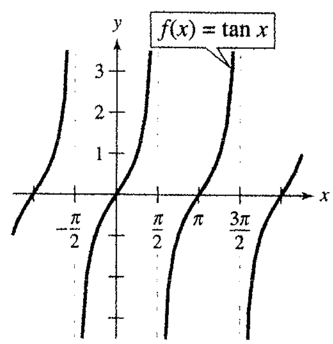
$f(x) = \cos x$



Domain: $(-\infty, \infty)$
Range: $[-1, 1]$
Period: 2π
x-intercepts: $\left(\dfrac{\pi}{2} + n\pi, 0\right)$
y-intercept: $(0, 1)$
Even function
y-axis symmetry

Tangent Function

$f(x) = \tan x$

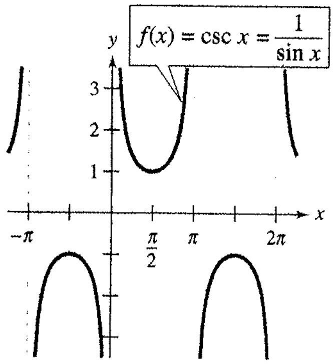


Domain: all $x \neq \dfrac{\pi}{2} + n\pi$
Range: $(-\infty, \infty)$
Period: π
x-intercepts: $(n\pi, 0)$
y-intercept: $(0, 0)$
Vertical asymptotes:
$$x = \frac{\pi}{2} + n\pi$$
Odd function
Origin symmetry

N100.

Cosecant Function

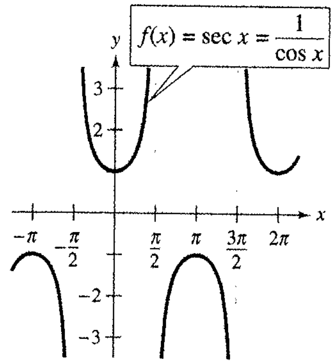
$f(x) = \csc x$



Domain: all $x \neq n\pi$
Range: $(-\infty, -1] \cup [1, \infty)$
Period: 2π
No intercepts
Vertical asymptotes: $x = n\pi$
Odd function
Origin symmetry

Secant Function

$f(x) = \sec x$



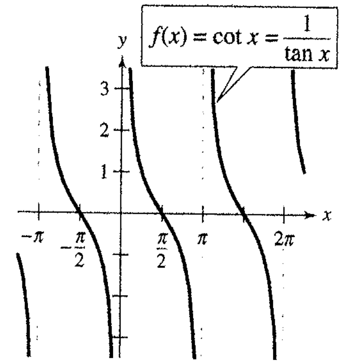
Domain: all $x \neq \dfrac{\pi}{2} + n\pi$
Range: $(-\infty, -1] \cup [1, \infty)$
Period: 2π
y-intercept: $(0, 1)$
Vertical asymptotes:

$$x = \frac{\pi}{2} + n\pi$$

Even function
y-axis symmetry

Cotangent Function

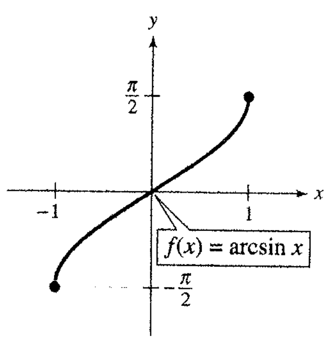
$f(x) = \cot x$



Domain: all $x \neq n\pi$
Range: $(-\infty, \infty)$
Period: π
x-intercepts: $\left(\dfrac{\pi}{2} + n\pi, 0\right)$
Vertical asymptotes: $x = n\pi$
Odd function
Origin symmetry

Inverse Sine Function

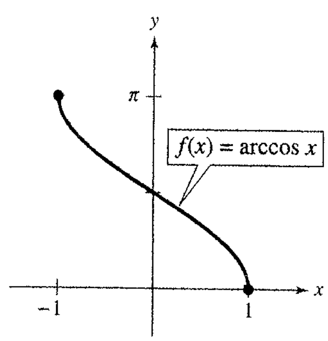
$f(x) = \arcsin x$



Domain: $[-1, 1]$
Range: $\left[-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right]$
Intercept: $(0, 0)$
Odd function
Origin symmetry

Inverse Cosine Function

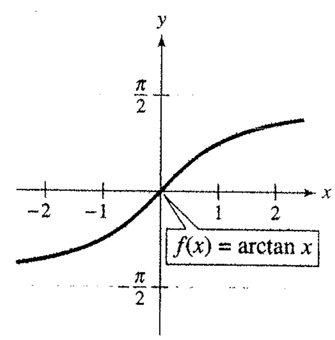
$f(x) = \arccos x$



Domain: $[-1, 1]$
Range: $[0, \pi]$
y-intercept: $\left(0, \dfrac{\pi}{2}\right)$

Inverse Tangent Function

$f(x) = \arctan x$



Domain: $(-\infty, \infty)$
Range: $\left(-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right)$
Intercept: $(0, 0)$
Horizontal asymptotes:

$$y = \pm\frac{\pi}{2}$$

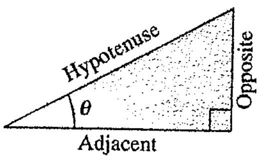
Odd function
Origin symmetry

N110.

TRIGONOMETRY

Definition of the Six Trigonometric Functions

Right triangle definitions, where $0 < \theta < \pi/2$.

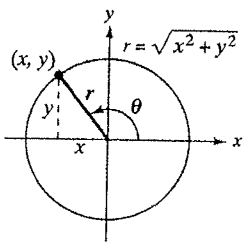


$$\sin\theta = \frac{\text{opp}}{\text{hyp}} \qquad \csc\theta = \frac{\text{hyp}}{\text{opp}}$$

$$\cos\theta = \frac{\text{adj}}{\text{hyp}} \qquad \sec\theta = \frac{\text{hyp}}{\text{adj}}$$

$$\tan\theta = \frac{\text{opp}}{\text{adj}} \qquad \cot\theta = \frac{\text{adj}}{\text{opp}}$$

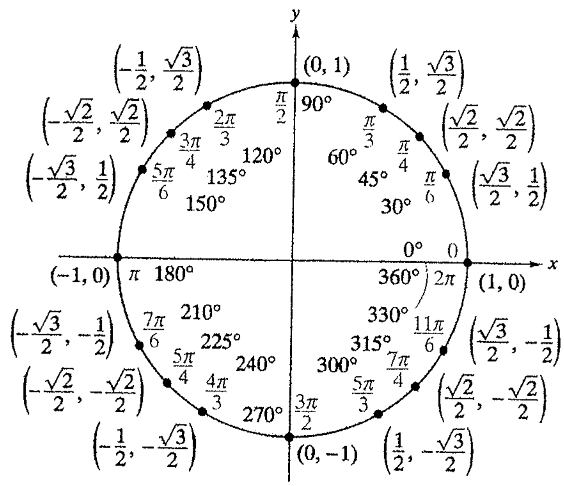
Circular function definitions, where θ is any angle.



$$\sin\theta = \frac{y}{r} \qquad \csc\theta = \frac{r}{y}$$

$$\cos\theta = \frac{x}{r} \qquad \sec\theta = \frac{r}{x}$$

$$\tan\theta = \frac{y}{x} \qquad \cot\theta = \frac{x}{y}$$



Reciprocal Identities

$$\sin x = \frac{1}{\csc x} \qquad \sec x = \frac{1}{\cos x} \qquad \tan x = \frac{1}{\cot x}$$

$$\csc x = \frac{1}{\sin x} \qquad \cos x = \frac{1}{\sec x} \qquad \cot x = \frac{1}{\tan x}$$

Tangent and Cotangent Identities

$$\tan x = \frac{\sin x}{\cos x} \qquad \cot x = \frac{\cos x}{\sin x}$$

Pythagorean Identities

$$\sin^2 x + \cos^2 x = 1$$

$$1 + \tan^2 x = \sec^2 x \qquad 1 + \cot^2 x = \csc^2 x$$

Cofunction Identities

$$\sin\left(\frac{\pi}{2} - x\right) = \cos x \qquad \cos\left(\frac{\pi}{2} - x\right) = \sin x$$

$$\csc\left(\frac{\pi}{2} - x\right) = \sec x \qquad \tan\left(\frac{\pi}{2} - x\right) = \cot x$$

$$\sec\left(\frac{\pi}{2} - x\right) = \csc x \qquad \cot\left(\frac{\pi}{2} - x\right) = \tan x$$

Reduction Formulas

$$\sin(-x) = -\sin x \qquad \cos(-x) = \cos x$$

$$\csc(-x) = -\csc x \qquad \tan(-x) = -\tan x$$

$$\sec(-x) = \sec x \qquad \cot(-x) = -\cot x$$

Sum and Difference Formulas

$$\sin(u \pm v) = \sin u \cos v \pm \cos u \sin v$$

$$\cos(u \pm v) = \cos u \cos v \mp \sin u \sin v$$

$$\tan(u \pm v) = \frac{\tan u \pm \tan v}{1 \mp \tan u \tan v}$$

Double-Angle Formulas

$$\sin 2u = 2 \sin u \cos u$$

$$\cos 2u = \cos^2 u - \sin^2 u = 2\cos^2 u - 1 = 1 - 2\sin^2 u$$

$$\tan 2u = \frac{2\tan u}{1 - \tan^2 u}$$

Power-Reducing Formulas

$$\sin^2 u = \frac{1 - \cos 2u}{2}$$

$$\cos^2 u = \frac{1 + \cos 2u}{2}$$

$$\tan^2 u = \frac{1 - \cos 2u}{1 + \cos 2u}$$

Sum-to-Product Formulas

$$\sin u + \sin v = 2\sin\left(\frac{u+v}{2}\right)\cos\left(\frac{u-v}{2}\right)$$

$$\sin u - \sin v = 2\cos\left(\frac{u+v}{2}\right)\sin\left(\frac{u-v}{2}\right)$$

$$\cos u + \cos v = 2\cos\left(\frac{u+v}{2}\right)\cos\left(\frac{u-v}{2}\right)$$

$$\cos u - \cos v = -2\sin\left(\frac{u+v}{2}\right)\sin\left(\frac{u-v}{2}\right)$$

Product-to-Sum Formulas

$$\sin u \sin v = \frac{1}{2}[\cos(u - v) - \cos(u + v)]$$

$$\cos u \cos v = \frac{1}{2}[\cos(u - v) + \cos(u + v)]$$

$$\sin u \cos v = \frac{1}{2}[\sin(u + v) + \sin(u - v)]$$

$$\cos u \sin v = \frac{1}{2}[\sin(u + v) - \sin(u - v)]$$

N120.

FOUR VIEWS OF THE SAME CONCEPTS

Cartesian Coordinates

$x = r \cdot \cos\theta$

$y = r \cdot \sin\theta$

"all you need to know"

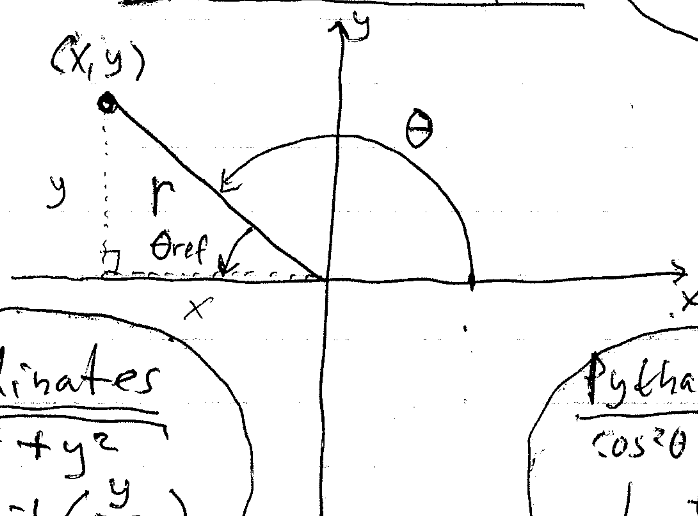
Trigonometric Ratios

$\cos\theta = \frac{x}{r}$, $\sec\theta = \frac{1}{\cos\theta}$

$\sin\theta = \frac{y}{r}$, $\csc\theta = \frac{1}{\sin\theta}$

$\tan\theta = \frac{\sin\theta}{\cos\theta} = \frac{y}{x}$, $\cot\theta = 1/\tan\theta$

COORDINATE SYSTEM



Polar Coordinates

$r = \sqrt{x^2 + y^2}$

$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

Pythagorean Identities

$\cos^2\theta + \sin^2\theta = 1$

$1 + \tan^2\theta = \sec^2\theta$

$1 + \cot^2\theta = \csc^2\theta$

FMC textbook explanations + 19 examples.

$\boxed{\text{p. 241}}$ UNIT CIRCLE, $r = 1$

$x = \cos\theta$

$y = \sin\theta$

$\boxed{\text{p. 243}}$ CIRCLE RADIUS r

$x = r\cos\theta$

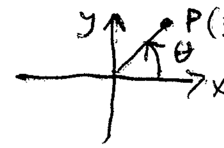
$y = r\sin\theta$

CIRCLE OF RADIUS r

$\boxed{\text{p. 247}}$ RADIAN = "ANGLE IN COUNTER-CLOCKWISE DIRECTION OF A UNIT CIRCLE SPANNING AN ARC OF LENGTH 1"

$\boxed{\text{p. 249}}$ Arclength, $s = r \cdot \underline{\theta_{radians}}$

$\boxed{\text{p. 279}}$ "Reference angle of θ is the angle between the the line joing P to the origin and the nearest part of the x-axis, $0^\circ < \theta < 90^\circ$ or $0 < \theta < \frac{\pi}{2}$."



$\boxed{\text{p. 248}}$ 1 radian $= \frac{180^\circ}{\pi} \doteq 57.296^\circ$

$\boxed{\text{p. 253}}$ EXACT VALUES FOR SPECIAL ANGLES.

$\cos(30^\circ) = \sqrt{3}/2$ etc.

$\boxed{\text{p. 267}}$ $\tan\theta = \frac{y}{x} = \text{slope} = \frac{\sin\theta}{\cos\theta}$

$\boxed{\text{p. 269}}$ $\cos^2\theta + \sin^2\theta = 1$

$1 + \tan^2\theta = \sec^2\theta$

$\boxed{\text{M130}}$

TRIGONOMETRIC FUNCTION GRAPHS: CALCULATOR EXPLORATIONS WITH TI-83

RESET DEFAULT

2nd MEM 722

- TURN ON EQUATIONS
- MODE DEGREE

2nd QUIT

MODE Degree 2nd QUIT (MODE)

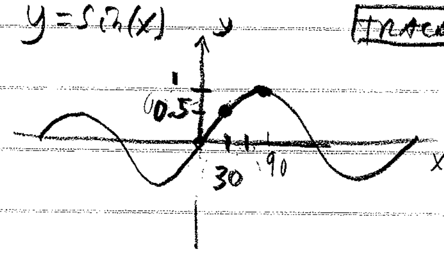
Y= $Y_1 = \sin(x)$

USE ENTER KEY TO TURN ON/OFF.

ZOOM 7:ZTRIG

TRACE

$y = \sin(x)$ TRACE ◀ ▶



RADIANS

MODE Radian

ZOOM 7:ZTRIG

TRACE

WINDOW

XMIN = −352.5
XMAX = 352.5
XSCL = 90

TRY TO CHANGE THESE TO −720, 720 GRAPH

YMIN = −4
YMAX = 4
YSCL = 1
XRES = 1

TRY TO CHANGE THESE TO −2, 2. GRAPH

GRAPH

2nd TABLE (GRAPH)

MODE Degree

2nd TBLSET (WINDOW)

TblStart = 0

ΔTbl = 15

Auto, Auto.

2nd TABLE (GRAPH)

Back to TBLSET = 0, 1

$Y_1 = \sin x$ ZOOM 7:ZTRIG

A	• $y_2 = 2\sin x$ vertical stretch
B	• $y_2 = 0.5\sin x$ shrink
C	• $y_2 = \sin(2x)$ horizontal shrink (period shorter)
D	• $y_2 = \sin(0.5x)$ stretch (period longer)
E	• $y_2 = \sin(x) + 2$ vertical shift up
F	• $y_2 = \sin(x) - 2$ down
G	• $y_2 = \sin(x - 40)$ horizontal shift right
H	• $y_2 = \sin(x + 40)$ left
I	• $y_2 = 1.5\sin(0.5(x - 40)) + 2$
J	• $y_2 = \cos(x)$
K	• $y_2 = \cos(90 - x) - 2$
L	• $y_2 = \tan(x)$

PARAMETRIC

MODE Par

MODE Degree

MODE Par

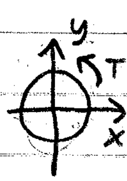
$X_{1T} = \cos(T)$

$Y_{1T} = \sin(T)$

WINDOW

TMIN 0
TMAX 720
TSTEP 7.5
XMIN −1.7
XMAX 1.7
XSCL 1
YMIN −1.1
YMAX 1.1
YSCL 1

TRACE



MODE Func

Back to MODE Func

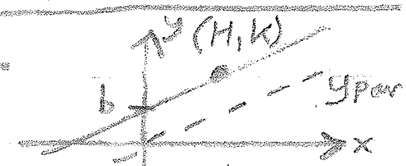
N140

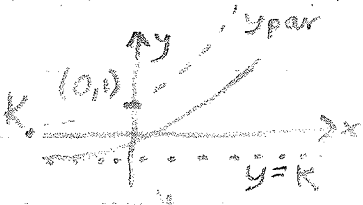
Functions: One-page Summary

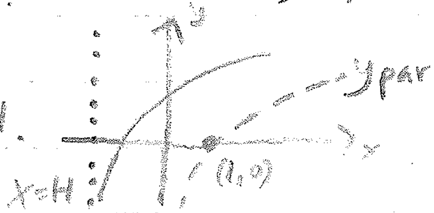
8/29/07
9/28/07 V.2.

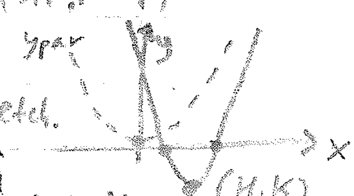
H, K = HORIZ + VERT. SHIFTS. A = VERT. STRETCH. B = HORIZ. SHRINK

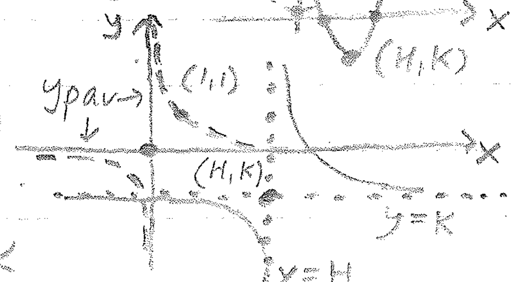
	PARENT (y_{par})	CHILD FUNCTIONS
LINE	$y = mx$	$y - K = m(X - H)$ point: (H,K). slope: m. y-intercept: $b = K - mH$
EXPONENTIAL	$y = e^x$	$y - K = Ae^{Bx}$ Horizontal asymptote $y = K$. Continuous rate constant = B.
LOGARITHMIC	$y = Ln(x)$	$y - K = Ln(X - H)$ Vertical asymptote $X = H$.
QUADRATIC	$y = X^2$	$y - K = A(X - H)^2$ Vertex: (H,K). A = Vertical Stretch.
RECIPROCAL	$y = \frac{1}{X}$	$y - K = \frac{1}{X - H}$ Vert. asy: $X = H$ Horiz asy: $y = K$
SINE	$y = \sin(x)$	$y - K = A \sin[B(X - H)]$ $\lvert A \rvert$ = Amplitude. $B = \frac{2\pi}{T}$. T = period. Horiz Stretch.











FUNCTION. X(DOMAIN) $\rightarrow$ $y = f(x)$ (RANGE), y UNIQUE. ZEROS: X when $f(x) = 0$.

INVERTIBLE (IF 1-TO-1). $f(g(x)) = g(f(x)) = x$

$y = f(x) \Leftrightarrow X = f^{-1}(y)$.

SYMMETRY. EVEN: $f(-x) = f(x)$

ODD: $f(-x) = -f(x)$

REFLECT ABOUT X-AXIS: $y = f(x)$ PARENT to $y = -f(x)$ CHILD

EXP-LOG. $e^u \cdot e^v = e^{u+v}$. $(e^u)^v = e^{u \cdot v}$. $Ln(u \cdot v) = Ln(u) + Ln(v)$. $Ln(u^v) = v \cdot Ln(u)$.

CONTINUOUS GROWTH $y = Ae^{|B|t}$ $y = A \cdot (S)^t$. $y = A\left(\frac{1}{2}\right)^{t/T}$ $y = A(2)^{t/T}$

DECAY $y = Ae^{-|B|t}$ B = contin. rate const. S = base T = half life or doubling time

COMPOUNDED (SEQUENCE / PIECEWISE FUNCTION WITH JUMPS): $y = A\left(1 + \frac{r}{100}\right)^t$. r = annual interest rate (%).

TRIG. CARTESIAN: $X = r\cos\theta$, $y = r\sin\theta$. POLAR: $r = \sqrt{x^2 + y^2}$, $\theta = \tan^{-1}\left(\frac{y}{x}\right)$.