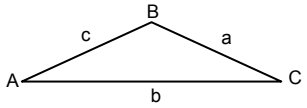
LAWS OF SINE, COSINE, AND TANGENT

In any triangle



Law of Sines

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Law of Cosines

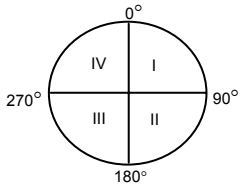
$a^2 = b^2 + c^2 - 2bc \cos A$ $\quad b^2 = a^2 + c^2 - 2ac \cos B$ $\quad c^2 = a^2 + b^2 - 2ab \cos C$

Law of Tangents

$$\frac{a + b}{a - b} = \frac{\tan[\frac{1}{2}(A + B)]}{\tan[\frac{1}{2}(A - B)]}$$

ALGEBRAIC SIGNS OF TRIG FUNCTIONS BY QUADRANT

Quad I	all positive (+)
Quad II	sin (+), cos (-), tan (-)
Quad III	sin (-), cos (-), tan (+)
Quad IV	sin (-), cos (+), tan (-)



TRIGONOMETRIC ELEVATION COMPUTATIONS

ζ_1	=	mean observed ZD	S	=	geodetic distances
sin 1″	=	0.00000485	T	=	slope distance

Reduction of Reciprocal Zenith Distance Observations

$$\text{Reduction in seconds} = -\frac{(HI - HT)\sin \text{mean ZD}}{S \sin 1''}$$

Reciprocal Observations

$h_2 - h_1 = T \sin \frac{1}{2}(ZD_2 - ZD_1)$ *or* $h_2 - h_1 = S \tan \frac{1}{2}(ZD_2 - ZD_1)$

Nonreciprocal Observations

$h_2 - h_1 = T \sin (90° - \zeta_1 + k)$ *or* $h_2 - h_1 = S \tan (90° - \zeta_1 + k)$

Legend:

C	C factor	cm	centimeter(s)	cos	cosine
cot	cotangent	csc	cosecant	FM	field manual
FS	far sight	ft	foot; feet	GTA	graphic training aid
in	inch(es)	kg	kilogram(s)	km	kilometer(s)
lb	pound(s)	LEC	linear error of closure	m	meter(s)
mi	mile(s)	mm	millimeter(s)	sec	secant
SIF	stadia-interval factor	sin	sine	SLC	sea level coefficient
t	grid azimuth	tan	tangent	ZD	zenith distance

*GTA 05-02-029

1 April 05

Conversion Factors and Common Formulas

Purpose: Use this GTA as a guide for making common conversions. See FM 3-34.331 for more information.

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Headquarters, Department of the Army

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CONVERSION FACTORS

Length

1 mm	= 0.100 cm	= 0.001 m	1 cm	= 0.3937 in	
10 mm	= 1.000 cm	= 0.010 m	1 in	= 2.54 cm	
100 mm	= 10.000 cm	= 0.100 m	1 m	= 39.37 in	= 3.28083 ft
1,000 mm	= 100.000 cm	= 1.000 m	1 ft	= 30.48 cm	= 0.30480 m
10 m	= 0.010 km		1 km	= 0.62137 mi	
100 m	= 0.100 km		1 mi	= 1609.344 m	= 1.60930 km
1,000 m	= 1.000 km				

Degrees

1 degree = 17.777777 mils 1 degree = $\frac{\pi}{180}$ radians 1 radian = $\frac{180}{\pi}$ degrees

Temperature

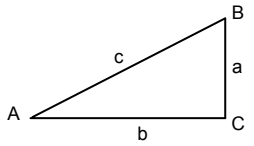
°C = 5/9(°F - 32) °F = (9/5 °C) + 32

Weight

1 lb = 0.4536 kg 1 kg = 2.2050 lb

COMMON FORMULAS

In any right triangle



Sine = $\frac{\text{opposite leg}}{\text{hypotenuse}}$ Sin A = $\frac{a}{c}$

Cosine = $\frac{\text{adjacent leg}}{\text{hypotenuse}}$ Cos A = $\frac{b}{c}$

Tangent = $\frac{\text{opposite leg}}{\text{adjacent leg}}$ Tan A = $\frac{a}{b}$

Cosecant = $\frac{1}{\text{sine}}$ Csc A = $\frac{1}{a/c} = \frac{c}{a}$

Secant = $\frac{1}{\text{cosine}}$ Sec A = $\frac{1}{b/c} = \frac{c}{b}$

Cotangent = $\frac{1}{\text{tangent}}$ Cot A = $\frac{1}{a/b} = \frac{b}{a}$

$c = \sqrt{a^2 + b^2}$ $a = \sqrt{c^2 - b^2}$ $b = \sqrt{c^2 - a^2}$

LEVELING ("C" FACTOR)

C factor = $\frac{\text{near rod reading – far rod reading}}{\text{far intervals – near intervals}}$

Maximum allowable C factor:

SIF	C
1:100	±0.003
1:200	±0.007
1:333	±0.010

Correct rod reading = C x last FS interval + last FS mean reading

BASIC COMPUTATIONS

Distance = $\sqrt{\Delta N^2 + \Delta E^2}$ Bearing (β) = tan $\frac{\Delta E}{\Delta N}$

t = grid azimuth

$t = \beta$	if	ΔE +	ΔN +
$t = 180° - \beta$	if	ΔE +	ΔN -
$t = 180° + \beta$	if	ΔE -	ΔN -
$t = 360° - \beta$	if	ΔE -	ΔN +

TRAVERSE COMPUTATIONS

K = scale factor (geodetic distance)

$K = K_o [1 + (XVIII) q^2 + 0.00003q^4]$

$K_o = 0.9996$

$q = 0.000001 \times E'$

K★ = scale factor (horizontal distance)

K★ = K x SLC

SLC = 1 – $\frac{\text{mean elevation}}{\text{mean radius of the earth}}$

Mean radius of the earth = 6,372,000 m (20,906,000 ft)

ΔN = grid distance x cosine of azimuth

ΔE = grid distance x sine of azimuth

LEC = $\sqrt{\text{error } \Delta N^2 + \text{error } \Delta E^2}$

Ratio of closure = 1: $\frac{\text{length (m)}}{\text{LEC}}$