

Possible Formulas for Final Exam in MATH 1113

$$\text{Slope (m)} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{Slope-intercept Form: } y = mx + b$$

$$\text{Point-Slope Form: } y - y_1 = m(x - x_1)$$

$$P \text{ of Rectangle} = 2L + 2W \text{ (add all sides)}$$

$$\text{Sum of Angles in Triangle} = 180$$

$$\text{Vertex of Parabola: } x = -\frac{b}{2a}$$

Horizontal asymptotes: numerator and denominator have same degree, line $y = a/b$ is asymptote

Numerator degree less than denominator degree, $y = 0$ is asymptote

Numerator degree is greater than denominator degree, no asymptote

Remainder Theorem: If a number “c” is substituted into the polynomial $f(x)$, then the result $f(c)$ is the remainder that would be obtained by dividing $f(x)$ by $(x - c)$.

Rational Zeros Theorem: Given a polynomial $P(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$, where all the coefficients are integers. Consider a rational number denoted by p/q , where p and q are relatively prime. If p/q is a zero of $P(x)$, the p is a factor of a_0 and q is a factor of a_n .

$$\text{Compound Interest: } A(t) = P \left(1 + \frac{r}{n} \right)^{nt}$$

$$\text{Change of Base: } \log_m N = \frac{\log N}{\log m}$$

Logarithm Basic Properties:

$$\log MN = \log M + \log N$$

$$\log \frac{M}{N} = \log M - \log N$$

$$\log M^N = N \bullet \log M$$

$$\log 10 = 1$$

$$\ln e = 1$$

$$\log_a a = 1$$

$$\log_a a^x = x$$

$$a^{\log_x a^x} = x$$

Population Growth: $P(t) = P_0 a^t$

P_0 = initial population

a = growth rate

t = time (unit determined by problem)

$P(t)$ = population size at time t

Radioactive Decay: $A(t) = A_0 a^t$

A_0 = initial value

a = growth/decay rate

t = time (unit determined by problem)

$A(t)$ = amount left after time t

Interest Compounded Continuously: $P(t) = P_0 e^{rt}$

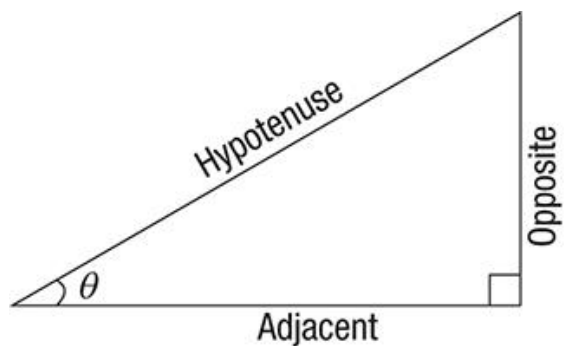
P_0 = initial value (principle)

r = growth rate

t = time in years

$P(t)$ = amount after time t

Right Triangle Definitions



$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\csc \theta = \frac{\text{hypotenuse}}{\text{opposite}}$$

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\sec \theta = \frac{\text{hypotenuse}}{\text{adjacent}}$$

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\cot \theta = \frac{\text{adjacent}}{\text{opposite}}$$

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

$$\sin x = \frac{1}{\csc x} \quad \csc x = \frac{1}{\sin x}$$

$$\cos x = \frac{1}{\sec x} \quad \sec x = \frac{1}{\cos x}$$

$$\tan x = \frac{1}{\cot x} \quad \cot x = \frac{1}{\tan x}$$

$$\sin \theta = \cos (90 - \theta)$$

$$\cos \theta = \sin (90 - \theta)$$

$$\tan \theta = \cot (90 - \theta)$$

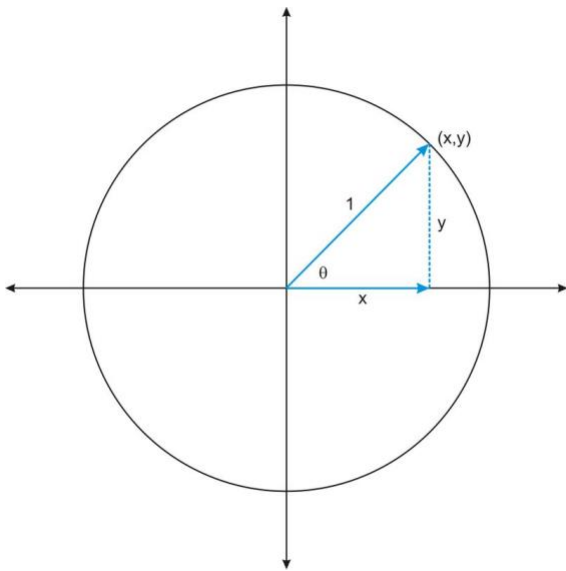
$$\cot \theta = \tan (90 - \theta)$$

$$\sec \theta = \csc (90 - \theta)$$

$$\csc \theta = \sec (90 - \theta)$$

Unit Circle Definition

Assume θ can be any angle



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

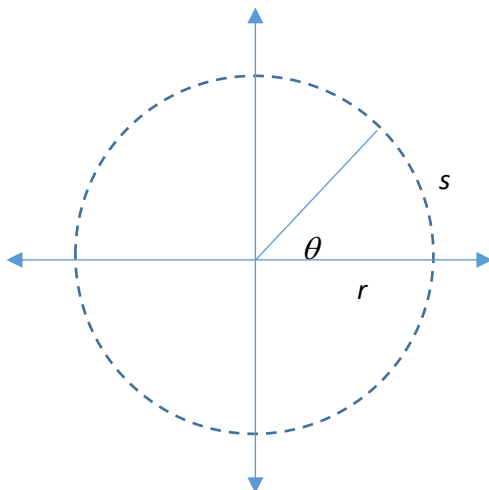
$$\cos \theta = \frac{x}{r}$$

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

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

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

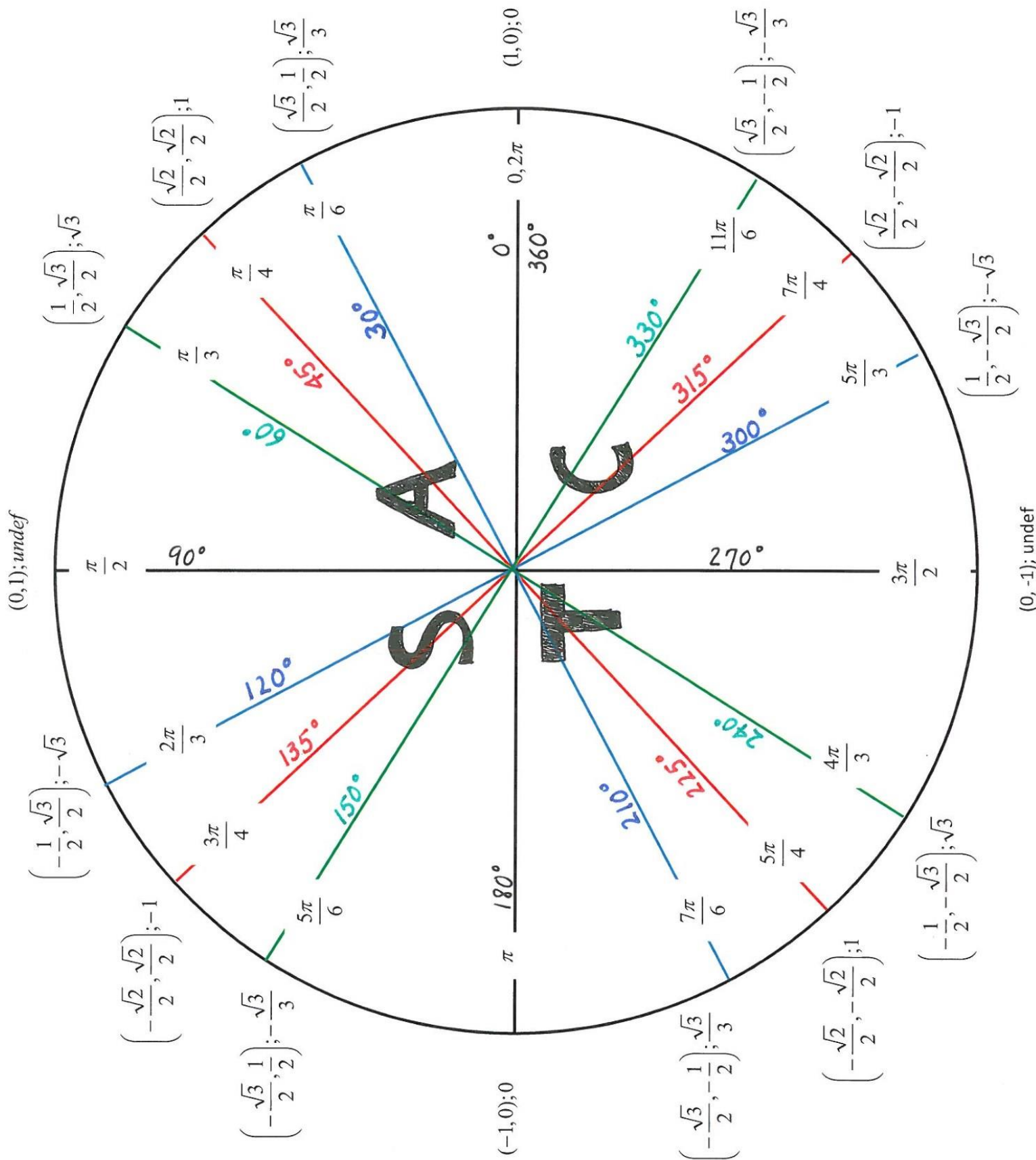
$$\cot \theta = \frac{x}{y}$$



$$\theta = \frac{s}{r}$$

$$v = r\omega$$

$$\omega = \frac{\theta}{t}$$



A	$\sin A$	$\cos A$	$\tan A$	$\cot A$	$\sec A$	$\operatorname{cosec} A$
0°	0	1	0	∞	1	∞
30°	$1/2$	$\sqrt{3}/2$	$1/\sqrt{3}$	$\sqrt{3}$	$2/\sqrt{3}$	2
45°	$\sqrt{2}/2$	$\sqrt{2}/2$	1	1	$\sqrt{2}$	$\sqrt{2}$
60°	$\sqrt{3}/2$	$1/2$	$\sqrt{3}$	$1/\sqrt{3}$	2	$2/\sqrt{3}$
90°	1	0	∞	0	∞	1

Formulas and Identities

Tangent & Cotangent Identities

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

Even/Odd Formulas

$$\sin(-\theta) = -\sin \theta \qquad \csc(-\theta) = -\csc \theta$$

$$\cos(-\theta) = \cos \theta \qquad \sec(-\theta) = \sec \theta$$

$$\tan(-\theta) = -\tan \theta \qquad \cot(-\theta) = -\cot \theta$$

Pythagorean Identities

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

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

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

Sum and Difference Formulas

$$\sin(\alpha \pm \beta) = \sin \alpha \cos \beta \pm \cos \alpha \sin \beta$$

$$\cos(\alpha \pm \beta) = \cos \alpha \cos \beta \mp \sin \alpha \sin \beta$$

$$\tan(\alpha \pm \beta) = \frac{\tan \alpha \pm \tan \beta}{1 \mp \tan \alpha \tan \beta}$$

Double Angle Formulas

$$\sin 2\theta = 2 \sin \theta \cos \theta$$

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

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

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

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

Product to Sum Formulas

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

$$\cos \alpha \cos \beta = \frac{1}{2} [\cos(\alpha - \beta) + \cos(\alpha + \beta)]$$

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

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

Sum to Product Formulas

$$\sin \alpha + \sin \beta = 2 \sin \left(\frac{\alpha + \beta}{2} \right) \cos \left(\frac{\alpha - \beta}{2} \right)$$

$$\sin \alpha - \sin \beta = 2 \cos \left(\frac{\alpha + \beta}{2} \right) \sin \left(\frac{\alpha - \beta}{2} \right)$$

$$\cos \beta + \cos \alpha = 2 \cos \left(\frac{\alpha + \beta}{2} \right) \cos \left(\frac{\alpha - \beta}{2} \right)$$

$$\cos \beta - \cos \alpha = 2 \sin \left(\frac{\alpha + \beta}{2} \right) \sin \left(\frac{\alpha - \beta}{2} \right)$$

Half Angle Formulas

$$\sin \frac{\theta}{2} = \pm \sqrt{\frac{1 - \cos \theta}{2}}$$

$$\cos \frac{\theta}{2} = \pm \sqrt{\frac{1 + \cos \theta}{2}}$$

$$\begin{aligned}\tan \frac{\theta}{2} &= \frac{\sin \theta}{1 + \cos \theta} \\ &= \frac{1 - \cos \theta}{\sin \theta}\end{aligned}$$

Cofunction Formulas

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

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

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

$$\sin\left(\theta \pm \frac{\pi}{2}\right) = \pm \cos \theta$$

$$\cos\left(\theta \pm \frac{\pi}{2}\right) = \mp \sin \theta$$

Degrees to Radians Formulas

If x is an angle in degrees and t is an angle in radians, then

$$\frac{\pi}{180} = \frac{t}{x} \Rightarrow t = \frac{\pi x}{180} \qquad x = \frac{180t}{\pi}$$

Other Identities

$$\cos^2 2x = \frac{1 + \cos 4x}{2}$$

$$\sin^2 2x = \frac{1 - \cos 4x}{2}$$

Inverse Trig Functions

Function

Domain

Range

$$y = \sin^{-1} x$$

$$[-1, 1]$$

$$\left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \text{ or Quadrants 4 and 1}$$

$$y = \cos^{-1} x$$

$$[-1, 1]$$

$$[0, \pi] \text{ or Quadrants 1 and 2}$$

$$y = \tan^{-1} x$$

$$(-\infty, \infty)$$

$$\left(-\frac{\pi}{2}, \frac{\pi}{2}\right) \text{ or Quadrants 4 and 1}$$

$$y = \csc^{-1} x$$

$$(-\infty, -1] \cup [1, \infty)$$

$$\left[-\frac{\pi}{2}, 0\right) \cup \left(0, \frac{\pi}{2}\right] \text{ or Quadrants 4 and 1}$$

$$y = \sec^{-1} x$$

$$(-\infty, -1] \cup [1, \infty)$$

$$\left[0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \pi\right] \text{ or Quadrants 1 and 2}$$

$$y = \cot^{-1} x$$

$$(-\infty, \infty)$$

$$(0, \pi) \text{ or Quadrants 1 and 2}$$

$$\text{Law of Sines: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{Law of Cosines: } a^2 = b^2 + c^2 - 2bc \cos A$$

$$b^2 = a^2 + c^2 - 2ac \cos B$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

Area of Triangle: $k = \frac{1}{2}$ product of 2 sides and sine of angle included angle

$$|a + bi| = \sqrt{a^2 + b^2}$$

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{Trig Notation} = z(\cos \theta + i \sin \theta)$$

$$\text{Standard Notation} = a + bi$$

$$\text{Multiplying: } z_1 z_2 [\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)]$$

$$\text{Dividing: } \frac{z_1}{z_2} [\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)]$$

$$\text{Powers: } |z|^n e^{in\theta}, \text{ argument between } [0^\circ, 360^\circ]$$

$$\text{Roots: } |z|^{\frac{1}{n}} e^{i\left(\frac{\theta + 2k\pi}{n}\right)}, \text{ where } k = 0, 1, 2, \dots, n-1$$

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$\text{Length of vector: } \|v\| = \sqrt{(v_1)^2 + (v_2)^2}$$

$$\text{angle between vectors: } \cos \theta = \frac{u \cdot v}{\|u\| \|v\|}$$

$$k \langle v_1, v_2 \rangle = \langle kv_1, kv_2 \rangle$$

$$u \bullet v = u_1 v_1 + u_2 v_2$$

$$u \pm v = \langle u_1 \pm v_1, u_2 \pm v_2 \rangle$$