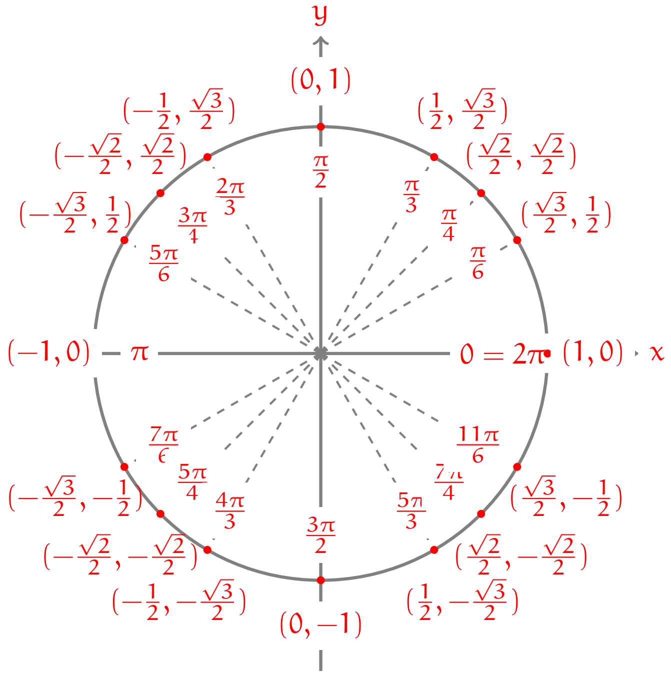

Integral Formulas.

- $\int \frac{1}{1+t^2}\, dt = \arctan t + C$
- $\int \frac{1}{\sqrt{1-t^2}}\, dt = \arcsin t + C$
- $\int \frac{1}{t}\, dt = \ln|t| + C$

Trig Identities.

- power reduction: $\cos^2\theta = \frac{1}{2} + \frac{1}{2}\cos 2\theta$
  $\sin^2\theta = \frac{1}{2} - \frac{1}{2}\cos 2\theta$
- double angle: $\sin 2\theta = 2\sin\theta\cos\theta$
  $\cos 2\theta = \cos^2\theta - \sin^2\theta$

A1 Formulas.

- $\vec{v}\cdot\vec{w} = \|\vec{v}\|\|\vec{w}\|\cos\theta$
- $\|\vec{v}\times\vec{w}\| = \|\vec{v}\|\|\vec{w}\|\sin\theta = [\text{parallelogram area}]$
- $|\vec{v}\cdot(\vec{w}\times\vec{r})| = [\text{parallelepiped volume}]$
- $\mathrm{proj}_{\vec{v}}(\vec{w}) = \left(\frac{\vec{v}\cdot\vec{w}}{\vec{v}\cdot\vec{v}}\right)\vec{v}$
- $\mathrm{comp}_{\vec{v}}(\vec{w}) = \frac{\vec{v}\cdot\vec{w}}{\|\vec{v}\|}$

A2 Formulas.

- distance from point B to plane $\mathcal{P}$ with normal $\vec{n}$:
  $\frac{|\overrightarrow{AB}\cdot\vec{n}|}{\|\vec{n}\|}$ where A is on $\mathcal{P}$
- distance from point B to line ℓ with direction $\vec{v}$:
  $\frac{\|\overrightarrow{AB}\times\vec{v}\|}{\|\vec{v}\|}$ where A is on ℓ

A3 Formulas. Standard equations.

- paraboloid: $z = x^2 + y^2$ 
- saddle: $z = x^2 - y^2$ 
- 1–sheeted hyperboloid: $x^2 + y^2 - z^2 = 1$ 
- 2–sheeted hyperboloid: $-x^2 - y^2 + z^2 = 1$ 
- ellipsoid—sphere if uniformly scaled:
  $x^2 + y^2 + z^2 = 1$ 
- double–cone: $z^2 = x^2 + y^2$ 

A4 Formulas.

- tangent plane to $z = f(x, y)$ at $(a, b, f(a, b))$ is:
  $z = f(a, b) + f_x(a, b)(x - a) + f_y(a, b)(y - b)$

A5 Formulas.

- given unit direction $\vec{u}$, the directional derivative:
  $D_{\vec{u}}f(P) = \vec{\nabla}f(P)\cdot\vec{u} = \|\vec{\nabla}f(P)\|\cos\theta$
- tangent plane to level set $F(x, y, z) = C$ at P is:
  $\vec{\nabla}F(P)\cdot\vec{x} = \vec{\nabla}F(P)\cdot\vec{p}$

B1 Formulas.

- If P is a critical point of $f(x, y)$ and:
  $D = f_{xx}(P)f_{yy}(P) - (f_{xy}(P))^2$
  $T = f_{xx}(P) + f_{yy}(P)$
- then:
  $D < 0 \implies$ saddle
  $D > 0$ and $T > 0 \implies$ local minimizer
  $D > 0$ and $T < 0 \implies$ local maximizer

B2 Formulas.

- An extremizer P of f subject to $g = C$ satisfies:
  $\vec{\nabla}f(P) = \lambda\vec{\nabla}g(P)$ or $\vec{\nabla}g(P) = \vec{0}$

B5 Formulas.

- polar and cylindrical
  - $r^2 = x^2 + y^2$ and $\tan\theta = \frac{y}{x}$
  - $x = r\cos\theta$ and $y = r\sin\theta$
  - $dA = r\ drd\theta$ and $dV = r\ dzdrd\theta$