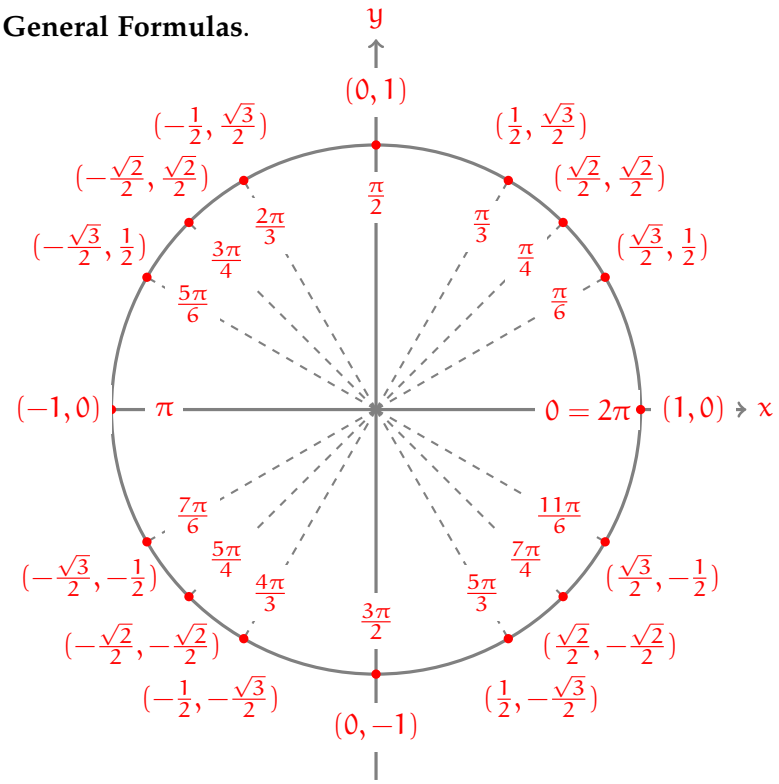
General Formulas.



A1 Formulas.

- products and lengths and angles:
  - $\mathbf{v} \cdot \mathbf{w} = \|\mathbf{v}\|\|\mathbf{w}\| \cos\theta$
  - $\|\mathbf{v} \times \mathbf{w}\| = \|\mathbf{v}\|\|\mathbf{w}\| \sin\theta$
- projection and scalar component:
  - $\text{proj}_{\mathbf{v}}(\mathbf{w}) = \left(\dfrac{\mathbf{v} \cdot \mathbf{w}}{\mathbf{v} \cdot \mathbf{v}}\right)\mathbf{v}$
  - $\text{comp}_{\mathbf{v}}(\mathbf{w}) = \dfrac{\mathbf{v} \cdot \mathbf{w}}{\|\mathbf{v}\|}$
- scalar triple product:
  - $\mathbf{v} \cdot (\mathbf{w} \times \mathbf{r}) = \mathbf{r} \cdot (\mathbf{v} \times \mathbf{w}) = \mathbf{w} \cdot (\mathbf{r} \times \mathbf{v})$

A2 Formulas.

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

A3 Formulas.

- standard form surfaces:
  - paraboloid: $\hat{z} = \hat{x}^2 + \hat{y}^2$
  - saddle: $\hat{z} = \hat{x}^2 - \hat{y}^2$
  - 1-sheeted hyperboloid: $\hat{x}^2 + \hat{y}^2 - \hat{z}^2 = 1$
  - 2-sheeted hyperboloid: $-\hat{x}^2 - \hat{y}^2 + \hat{z}^2 = 1$
  - ellipsoid: $\hat{x}^2 + \hat{y}^2 + \hat{z}^2 = 1$
  - double-cone: $\hat{z}^2 = \hat{x}^2 + \hat{y}^2$

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.

- $D_{\mathbf{u}} f(P) = \nabla f(P) \cdot \mathbf{u}$ where $\mathbf{u}$ is a unit vector
- tangent plane to $F(x, y, z) = C$ at P is:
  - $\nabla F(P) \cdot (\mathbf{x} - \mathbf{p}) = 0$