



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.

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

A2 Formulas.

- distance from point B to plane P with normal \vec{n} :

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

$$\frac{\|\vec{AB} \times \vec{v}\|}{\|\vec{v}\|}$$
 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:

$$\vec{\nabla} F(P) \cdot \vec{x} = \vec{\nabla} F(P) \cdot \vec{p}$$