

Formula Sheet

- $\mathbf{u} \cdot \mathbf{v} = |\mathbf{u}||\mathbf{v}| \cos \theta$ and $|\mathbf{u} \times \mathbf{v}| = |\mathbf{u}||\mathbf{v}| \sin \theta$
- The arc length of a curve $\mathbf{r}(t)$ for $a \leq t \leq b$ is given by

$$L = \int_a^b |\mathbf{v}(t)| dt,$$

where $\mathbf{v}(t) = \frac{d\mathbf{r}}{dt}$.

- Distance from point S to a line passing through point P , parallel to \mathbf{v} : $d = \frac{|\mathbf{PS} \times \mathbf{v}|}{|\mathbf{v}|}$.
- Given point S in space, and a plane with normal \mathbf{n} and point P on the plane, the distance from S to the plane is $d = \frac{|\mathbf{PS} \cdot \mathbf{n}|}{|\mathbf{n}|}$.
- Trigonometric identities:

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

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

$$\sin 2x = 2 \sin x \cos x$$

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

$$\sin^2 x = (1 - \cos 2x)/2$$

$$\cos^2 x = (1 + \cos 2x)/2$$

- For a plane curve given by $x = f(t)$ and $y = g(t)$, the derivative is given by

$$\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$$

provided $dx/dt \neq 0$.

- The length of a parametric curve for $a \leq t \leq b$ is given by $L = \int_a^b \sqrt{[dx/dt]^2 + [dy/dt]^2} dt$.
- Areas of surfaces of revolution:

$$\text{about } x\text{-axis } (y \geq 0): S = \int_a^b 2\pi y \sqrt{[dx/dt]^2 + [dy/dt]^2} dt$$

$$\text{about } y\text{-axis } (x \geq 0): S = \int_a^b 2\pi x \sqrt{[dx/dt]^2 + [dy/dt]^2} dt$$

- Polar coordinates:

$$x = r \cos \theta$$

$$y = r \sin \theta$$

$$r = \sqrt{x^2 + y^2}$$

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

- The area enclosed by a polar curve $r = f(\theta)$ between two angles θ_1 and θ_2 is given by

$$\frac{1}{2} \int_{\theta_1}^{\theta_2} r^2 d\theta = \frac{1}{2} \int_{\theta_1}^{\theta_2} (f(\theta))^2 d\theta.$$