Dot product:

$$a \cdot b = |a||b|cos(\theta)$$

Cross product: To find the cross product of a and b find the determinant of 3x3 matrix with unit vectors: $\mathbf{i}, \mathbf{j}, \mathbf{k}$ for the first row.

$$|a \times b| = |a|b|sin(\theta)$$

Vector equation of a line starting at point P, (a, b, c), with parralel vector $\vec{v}$, $\langle d, e, f \rangle$, and paramater t:

$$r(t) = P + t\vec{v} = \langle a + dt, b + et, c + ft \rangle$$

Given a constant point P_0, (x_0, y_0, z_0) and a point on the plane P, (x, y, z), the vector $\vec{P_0P}$ must be orthogonal to the normal vector of the plane N, $\langle a, b, c \rangle$. Therefore,

$$N \cdot \vec{P_0P} = 0$$

and

$$a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$$

.

Given vector function $r(t) = \langle f(t), g(t), h(t) \rangle$,

$$r'(t) = \langle f'(t), g'(t), h'(t) \rangle$$

and

$$R(t) = \langle F(t), G(t), H(t) \rangle$$

Length of curve from a to b is:

$$\int_a^b |r'(t)|dt$$

,

$$s(t) = \int_0^t |r'(x)|dx$$

. An equation $y = f(x)$ can be paramaterized as $r(t) = \langle t, f(t) \rangle$. The unit tangent vector: $T(t) = r'(t)/|r'(t)|$. The principle unit normal vector: $N(t) = T'(t)/|T'(t)|$. The binomial vector: $B = T \times N$. The osculating plane is the one formed by T and N. Curvature:

$$\kappa(x) = |\frac{dT}{ds}| = \frac{|T'(t)|}{|r'(t)|} = \frac{|r'(t) \times r''(t)|}{|r'(t)|^3}$$

. Torsion:

$$\gamma(x) = -N \cdot \frac{dB}{ds} = \frac{(r'(t) \times r''(t)) * r'''(t)}{|r'(t) \cdot r''(t)|}$$