Integration:

$$\int_{g} f(z)dz = \int_{t=a}^{t=b} f\{z(t)\}\frac{dz}{dt}dt$$

Cauchy's Theorem:

Jordan contour: *contour with no intersections.*

Let g be a close Jordan contour in a domain *D*, and let *f(z)* be a regular function inside g , and continuous on g . (i.e. g does not enclose any singularities).
Then:

$$\oint_{g} f(z)dz = 0$$ regular – thus Cauchy-Riemann holds.

Green's Theorem:

$$\int_{g} Pdx + Qdy = \int_{A}\left[\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right]dxdy$$ - use to "prove" Cauchy's Theorem.

Corollary 1:

$$\int_{g} f(z)dz = \int_{\hat{g}} f(z)dz$$

Independent of path. Only dependant upon end points.

Corollary 2:

Let *f(z)* be regular in *D*. Let z_1, z_2 be elements of *D*.
Define:

$$F(z) = \int_{z_1}^{z_2} f(z)dz$$

Then:

(i) *F(z)* also regular in *D*;

(ii) $F'(z) = f(z)$;

(iii) $\int_{z_1}^{z_2} f(z)dz = \int_{z_1}^{z_2} F'(z)dz = F(z_1) - F(z_2)$

Hence, normal rules of integration apply.

Corollary 3:

Let *f(z)* be regular in a region bounded by two closed Jordan contours g_1, g_2.
g_1 inside g_2. Then:

$$\oint_{g_1} f(z)dz = \oint_{g_2} f(z)dz$$

- can deform/shrink contours.

All of above *D* is a simply connected domain.