Summary of All Vector Calculus Theorems & Formulas

Since many different types of integrals have been learned in this chapter, as well as many theorems and formulas related to these integrals, here is a list of all the formulas related to Vector Calculus

Fundamental Theorem of Calculus

> $$\int_a^b F'(x)dx = F(b) - F(a)$$

- This is included as a reminder that most of these formulas stem from extensions of FTC

Fundamental Theorem for Line Integrals

> $$\int_a^b \nabla f \cdot d\vec{r} = f(\vec{r}(b)) - f(\vec{r}(a))$$

- Since the gradient (∇f) is a sort of derivative, this is simply just a restatement of the Fundamental Theorem of Calculus- and since it relates the vector function $\vec{r}$ this means that we can relate line integrals in the way that the traditional FTC does

Green's Theorem

> $$\int_C \vec{F} \cdot d\vec{r} = \iint_D \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) dA$$

- The line integral of a curve C that bounds a given domain D is equal to the double integral of $Q_x - P_y$ over the region D

STOKES' THEOREM

> $$\int_C \vec{F} \cdot d\vec{r} = \iint_S \text{curl } \vec{F} \cdot d\vec{S}$$

- The line integral around the boundary curve of S of the tangential component of $\vec{F}$ is equal to the surface integral of the normal component of the curl of $\vec{F}$

Divergence Theorem

> $$\iint \vec{F} \cdot d\vec{S} = \iiint_E \operatorname{div} F \, dV$$

- The flux of $\vec{F}$ across the boundary surface of E is equal to the triple integral of the divergence of $\vec{F}$ over E