Fundamental Theorem of Calculus

IF f IS A CONTINUOUS FUNCTION ON THE INTERVAL $[a, b]$, AND F IS **ANY** ANTIDERIVATIVE OF f ON $[a, b]$, THEN

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

IF f IS CONTINUOUS, a IS IN ITS DOMAIN, AND F IS DEFINED BY

$$F(x) = \int_a^x f(t)\,dt$$

THEN F IS DIFFERENTIABLE, AND $F'(x) = f(x)$.

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$$\frac{d}{dx}\left[\int_0^x \sqrt{t^2+4}\,dt\right] \text{ here } f(t)=\sqrt{t^2+4}$$

$$\text{so } \frac{d}{dx}\left[\int_0^x f(t)\,dt\right]=\frac{d}{dx}\left[F(t)\Big|_0^x\right]=$$

$$\frac{d}{dx}\left[F(x)-F(0)\right]= f(x)\frac{d}{dx}(x)-f(0)\frac{d}{dx}(0)=\sqrt{x^2+4}-0=\sqrt{x^2+4}$$

Fundamental Theorem of Calculus

$$\frac{d}{dx}\left[\int_x^5 \sqrt{t^3+5}\; dt\right] \text{ here } f(t)=\sqrt{t^3+5}$$

$$\text{so } \frac{d}{dx}\left[\int_x^5 f(t)\,dt\right] = \frac{d}{dx}\left[F(t)\Big|_x^5\right] =$$

$$\frac{d}{dx}\left[F(5)-F(x)\right] = f(5)\frac{d}{dx}(5) - f(x)\frac{d}{dx}(x) = 0-\sqrt{x^3+5} = -\sqrt{x^3+5}$$

Fundamental Theorem of Calculus

$$\frac{d}{dx}\left[\int_5^{x^2} \sqrt{t^3-4}\,dt\right] \text{ here } f(t)=\sqrt{t^3-4}$$

$$\text{so } \frac{d}{dx}\left[\int_5^{x^2} f(t)\,dt\right] = \frac{d}{dx}\left[F(t)\Big|_5^{x^2}\right] =$$

$$\frac{d}{dx}\left[F(x^2)-F(5)\right] = f(x^2)\frac{d}{dx}(x^2) - f(5)\frac{d}{dx}(5) = \sqrt{x^6-4}\cdot 2x - 0 = 2x\sqrt{x^6-4}$$