Fundamental Theorem of Calculus

Let f = continuous on $[a,b]$

1) If $g(x) = \int_a^x f(t)\,dt$, Then $g'(x) = f(x)$

2) $\int_a^b f(x)\,dx = F(b) - F(a)$, where F is any antiderivative of f
$F'(x) = f(x)$

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

$$g'(x) = F'(x) - 0 = f(x)$$

$$\int_{-1}^{3} x^2\,dx = \frac{x^3}{3}\Big|_{-1}^{3} = \frac{3^3}{3} - \frac{(-1)^3}{3} = 9 - -\frac{1}{3} = 9 + \frac{1}{3} = \frac{28}{3}$$

$$= \left(\frac{x^3}{3} + c\right)\Big|_{-1}^{3} = \left(\frac{3^3}{3} + c\right) - \left(\frac{(-1)^3}{3} + c\right) = 9 + c - \frac{(-1)}{3} - c$$

$$g(x) = \int_0^x e^{-\sin(\sqrt{t})} \sec(\ln(7^t))\,dt$$

$$g'(x) = e^{-\sin(\sqrt{x})} \sec(\ln(7^x))$$

$$g(x) = \int_x^5 e^{-\sin(\sqrt{t})} \sec(\ln(7^t))\,dt = -\int_5^x e^{-\sin(\sqrt{t})} \sec(\ln(7^t))\,dt$$

$$g'(x) = -e^{-\sin(\sqrt{x})} \sec(\ln(7^x)) \qquad \int_x^5 f(t)\,dt = F(5) - F(x)$$

$$g(x) = \int_3^{\sin(x)} \sqrt[4]{t^9 - \cos(t^{15})}\,\log_{12}(\tan(t))\,dt$$

$$g'(x) = \left[\sqrt[4]{\sin^9(x) - \cos(\sin^{15}(x))}\,\log_{12}(\tan(\sin(x)))\right]\cos(x)$$

$$g(x) = \int_{\ln(x)}^{\sqrt{x}} \csc^{23}\left(\sqrt{\ln\left(\tan^{-1}\left(\frac{5}{t+1}\right)\right)}\right)dt$$

$$g'(x) = \csc^{23}\left(\sqrt{\ln\left(\tan^{-1}\left(\frac{5}{\sqrt{x}+1}\right)\right)}\right)\frac{1}{2\sqrt{x}} - \csc^{23}\left(\sqrt{\ln\left(\tan^{-1}\left(\frac{5}{\ln(x)+1}\right)\right)}\right)\frac{1}{x}$$

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