The Second Fundamental Theorem of Calculus

$$\boxed{\frac{d}{dx}\int_a^x f(t)\,dt = f(x)}$$

$$\frac{d}{dx}\int_3^x \sqrt{\sec\sqrt{t}}\,dt = \sqrt{\sec\sqrt{x}}$$

$$\frac{d}{dx}\int_a^x f(t)\,dt = \frac{d}{dx}\left[F(t)\Big|_a^x\right]$$

$$= \frac{d}{dx}\left[F(x) - F(a)\right]$$

$$= f(x)$$

$$\boxed{\frac{d}{dx}\int_{g(x)}^{h(x)} f(t)\,dt = f(h(x))\,h'(x) - f(g(x))\,g'(x)}$$

$$\frac{d}{dx}\int_{g(x)}^{h(x)} f(t)\,dt = \frac{d}{dx}\left[F(t)\Big|_{g(x)}^{h(x)}\right]$$

$$= \frac{d}{dx}\left[F(h(x)) - F(g(x))\right]$$

$$= F'(h(x))h'(x) - F'(g(x))g'(x)$$

$$= f(h(x))h'(x) - f(g(x))g'(x)$$

$$\frac{d}{dx}\int_3^x \sqrt{t-4}\,dt = \sqrt{x-4}\;\cancel{(1) - \sqrt{3-4}\,(0)}$$

$$\frac{d}{dx}\int_{\sqrt{x}}^{x^3} \sec t^2\,dt = (\sec x^6)(3x^2) - (\sec x)\,\frac{1}{2\sqrt{x}}.$$

Given $F(x) = \int_2^x \sqrt{t-1}\, dt$ find $F(2)$, $F'(2)$, $F''(2)$.

$F(2) = 0$

$F'(x) = \sqrt{x-1} \longrightarrow F'(2) = 1$

$F''(x) = \dfrac{1}{2\sqrt{x-1}} \longrightarrow F''(2) = \dfrac{1}{2}$.

Given $H(x) + 4 = \int_3^x (t^3 - t)\,dt$ $\quad H(3) \quad H'(3)$

$H''(3)$

$$H(x) = -4 + \int_3^x (t^3 - t)\,dt$$

$$H(3) = -4 + 0 = -4$$

$$H'(x) = x^3 - x \rightarrow H'(3) = 24$$

$$H''(x) = 3x^2 - 1 \rightarrow H''(3) = 26$$

$$\frac{d}{dx}\int_x^4 \sqrt{t}\,dt = -\frac{d}{dx}\int_4^x \sqrt{t}\,dt$$

$$= -\sqrt{x}$$