Fundamental Theorem of Calculus (FTC)

If a function f is continuous on $[a,b]$ and F is an antiderivative of f on $[a,b]$ then

$$\int_a^b f(x)\,dx = \underbrace{F(b) - F(a)}_{\text{change in amount}}$$

$$* \; F(b) = \int_a^b f(x)\,dx + F(a) \Rightarrow \text{finding new values}$$

$$\int_a^b f'(x)\,dx = f(b) - f(a) \Rightarrow f(b) = \int_a^b f'(x)\,dx + f(a)$$

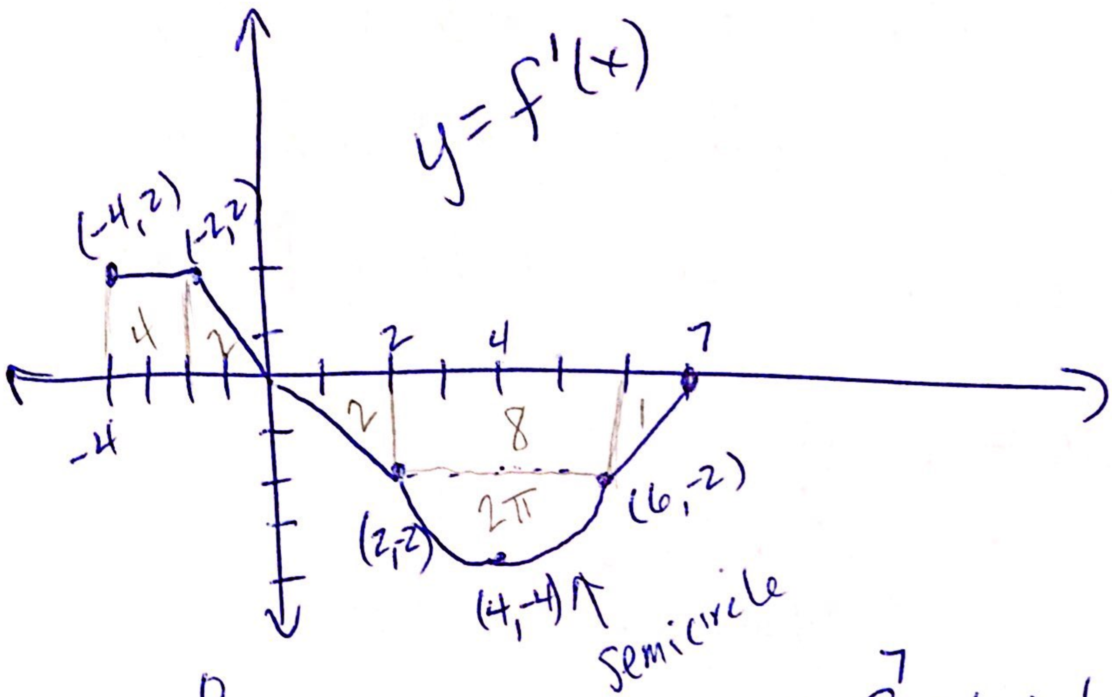
$$\int_a^b v(t)\,dt = \underbrace{s(b) - s(a)}_{\text{change in position}}$$

Ex. $$\int_{-1}^{2} (x^2-3)\,dx = \frac{1}{3}x^3 - 3x + c \Big|_{-1}^{2} = \left(\frac{1}{3}(2)^3 - 3(2) \cancel{+c}\right) - \left(\frac{1}{3}(-1)^3 - 3(-1) \cancel{+c}\right)$$

$$= \frac{8}{3} - 6 + \frac{1}{3} - 3 = \boxed{-6}$$

Ex. $$\int_0^{\pi/4} 3\sin x\,dx = -3\cos x \Big|_0^{\pi/4} = -3\cos\frac{\pi}{4} - (-3\cos 0)$$

$$= \boxed{\frac{-3\sqrt{2}}{2} + 3}$$



a) $\int_{-4}^{0} f'(x)\,dx =$ ______

b) $\int_{0}^{7} f'(x)\,dx =$ ______

c) $\int_{-4}^{7} f'(x)\,dx =$ ______

d) $\int_{-4}^{7} (f'(x)+3)\,dx =$ ______

e) $f(0) = 6$. Find $f(2)$.

Find $f(-4)$.

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2^{nd} Part of FTC

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

$$\frac{d}{dx}\left[\int_3^x (t^2+4)\,dt\right] = \frac{d}{dx}\left[\frac{1}{3}t^3+4t\Big|_3^x\right] = \frac{d}{dx}\left[\frac{1}{3}x^3+4x-(9+12)\right]$$

$$= \boxed{x^2+4}$$

$$\frac{d}{dx}\int_{-2}^{x} t^3\sqrt{\tan t}\,dt = \boxed{x^3\sqrt{\tan x}}$$

$$\frac{d}{dx}\int_{x}^{4} t^3\sqrt{\tan t}\,dt = \boxed{-x^3\sqrt{\tan x}}$$

Chain Rule

$$\frac{d}{dx}\int_0^{x^2} \sin t\,dt = 2x\sin x^2$$

$$\frac{d}{dx}\int_{-3}^{\cos x} \sqrt{t^3-3t}\,dt = \boxed{-\sin x\sqrt{\cos^3 x-3\cos x}}$$

$$\frac{d}{dx}\int_{\sqrt{x}}^{\sec x} t\sqrt{\cos t}\,dt = \sec x\tan x\cdot\sec x\sqrt{\cos(\sec x)} - \frac{1}{2}x^{-1/2}\cdot\sqrt{x}\sqrt{\cos\sqrt{x}}$$