4.9 Antiderivatives

Idea: Given the derivative of a function, find the original function. Given the slope of a function at every point, find the function itself. Given the velocity of an object, find its position (displacement) function. Given the acceleration of an object, find its velocity.

Definition: If $F'(x) = f(x)$ for all $x \in (a, b)$, then F is an antiderivative of f on (a, b).

function f	antiderivative F	integral notation
$\boldsymbol{k}$		
$\boldsymbol{x^n}$		
$\boldsymbol{\frac{1}{x}}$		
$\boldsymbol{\cos x}$		
$\boldsymbol{\cos(ax+b)}$		
$\boldsymbol{\sin x}$		
$\boldsymbol{\sin(ax+b)}$		
$\boldsymbol{e^x}$		
$\boldsymbol{ae^{bx}}$		
$\boldsymbol{\sec^2 x}$		
$\boldsymbol{\frac{1}{x^2+1}}$		

1. Find the general antiderivative of $f(x) = 5x^4 - 6x + \dfrac{6}{x^5} + \sqrt[3]{x} + \sin\left(\dfrac{x}{2}\right) + 7 - 6e^{3x}$.

2. Find the general antiderivative of $f(x) = \dfrac{-2}{\sqrt[5]{x^2}} + \sqrt[4]{x^5} + \cos(2\pi x) - 4x^5 + 7x - 6 + e^{x/2}$.

3. Find $f(x)$ if $f''(x) = -36x^2 + 12x$ with $f'(1) = -1$ and $f(1) = -2$.

4. A particle moving horizontally along the $x-$axis has acceleration $a(t) = 10 + 3t - 3t^2$ feet/second^2, where $t \geq 0$. Find the position function $s(t)$ assuming the particle satisfies $s(0) = 0$ and $s(2) = 10$.

5. A car brakes with a constant deceleration (negative acceleration) of 40 feet per second^2, producing skid marks 160 feet long before coming to a complete stop. How fast was the car traveling when the brakes were applied?

Homework: (348 – 349) 26, 28, 34, 46, 62, 64, **and** the following: A car is traveling at **100** km per hour when the driver sees an accident **80** meters ahead and slams on the brakes. What constant deceleration is required to stop the car in time to avoid a collision?