AP Calculus
Unit 6 – Basic Integration & Applications

Day 1 Notes: Finding Anti-Derivatives of Polynomial-Type Functions

If you had to explain to someone how to find the derivative of a polynomial-type function, what would you say?

To find the anti-derivative, you would do the opposite of each one of those operations and in the reverse order. Therefore, to find the anti-derivative of a polynomial-type function….

The **anti-derivative (indefinite integral)** of a function, $f(x)$, is denoted by the notation $\int f(x)dx$. So when finding the anti-derivative of a function, you are finding the function of which $f(x)$ is the first derivative. This will enable us, if given f' or f'' to be able to find f. However, if $\int f'(x)dx = f(x)$, what problem do you foresee?

Find each of the following anti-derivatives.

$\int\left(3x^2+2x+3\right)dx$	$\int\left(\frac{x^3+2x-4}{x}\right)dx$
$\int(x+2)(2x-3)dx$	$\int\frac{2}{\sqrt{x}}\,dx$

We learned that $\frac{d}{dx}[\sin x]=\cos x$ and $\frac{d}{dx}[\cos x]=-\sin x$. Similarly, write what the anti-derivatives of sine and cosine are.

$\int\cos x\,dx=$ ____________________ $\int\sin x\,dx=$ ____________________

Find each of the following anti-derivatives.

$\int(2\sin x+\cos x)dx$	$\int\left(t^2-\sin t\right)dt$

$\int (4x - 3\cos x)dx$	$\int (\sqrt{x} + \sin x)dx$

Use the given information about $f\,'$ and $f\,''$ to find $f(x)$.

1. $f\,''(x) = 2$ $f\,'(2) = 5$ $f(2) = 10$	2. $f\,''(x) = x^{-3/2}$ $f\,'(4) = 2$ $f(0) = 0$

An evergreen nursery usually sells a certain shrub after 6 years of growth and shaping. The growth rate during those 6 years is approximated by the differential equation

$$\frac{dh}{dt} = 1.5t + 5,$$

where *t* is the time in years and *h* is the height in centimeters. The seedlings are 12 centimeters tall when planted, at *t* = 0.

a. Find the value of the differential equation above when $t = 3$. Using correct units of measure, explain what this value represents in the context of this problem.

b. Find an equation for $h(t)$, the height of the shrubs at any year t. Then, determine how tall the shrubs are when they are sold.

A particle moves along the *x* – axis at a velocity of $v(t) = \frac{1}{\sqrt{t}}$**, for *t* > 0. At time *t* = 1, its position is 4.**

a. What is the acceleration of the particle particle when $t = 9$?

b. What is the position of the when $t = 9$?

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Unit 6 – Day 1 – Assignment

For problems 1 – 12, find the indefinite integrals below.

1. $\int \left(\sqrt[3]{x}+3\right)dx$	2. $\int \left(2x-3x^2\right)dx$
3. $\int x^2\left(2x^2+3x\right)dx$	4. $\int \left(x^{3/2}+2x+1\right)dx$
5. $\int \left(\sqrt{x}+\frac{1}{2\sqrt{x}}\right)dx$	6. $\int \frac{3x^2-2x+3}{x^3}\,dx$
7. $\int y^3\sqrt{y}\;dy$	8. $\int \frac{1}{w\sqrt{w}}\,dw$

9. $\int \frac{x^3+3}{\sqrt{x}}\,dx$	10. $\int (x+3)(x-3)^2\,dx$
11. $\int \left(\theta^2+\cos\theta\right)d\theta$	12. $\int \left(\sqrt{x}-\sin x+2\right)dx$

For problems 13 and 14, find the indicated function based on the given information.

13. If $f'(x)=2x-\sin x$ and $f(0) = 4$, find $f(x)$.	14. If $f''(x)=x^2$, $f'(0)=6$, and $f(0)=3$, find $f(x)$.