وزارة التعليم العالي والبحث العلمي
المعهد التقني/ السماوة
قسم المساحة

اسم المادة : Mathematics and Spherical Triangles

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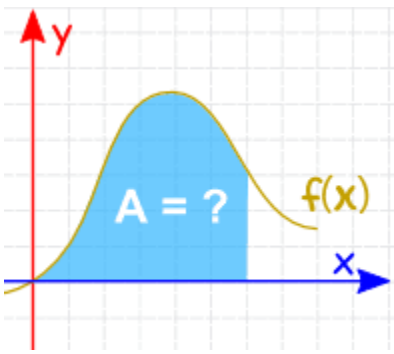
- Integration
- Indefinite Integral
- Integration of algebraic functions

Integration

Integration can be used to find areas, volumes, central points and many useful things. It is often used to find the area underneath the graph of a function and the x-axis. You will come across, two types of integrals in maths:

- Indefinite Integral
- Definite Integral



Indefinite Integral

Indefinite integrals are defined without upper and lower limits. It is represented as:

$\int f(x)dx = F(x) + C$

Where C is any constant and the function f(x) is called the integrand.

Integration of algebraic functions

- $\int 1 \, dx = x + c$

- $\int x^n \, dx = x^{n+1} / n + 1 + c$
- $\int a \, dx = ax + c$
- $\int f(x)\,dx = F(x) + C$
- $\int pf(x)\,dx = p\int f(x)\,dx$
- $\int [f(x) + g(x)]dx = \int f(x)\,dx + \int g(x)\,dx$
- $\int f(x)\,dx - \int g(x)\,dx = C$

$$\int f(x)\,dx = \int g(x)\,dx + C$$

Example: What is $\int 6x^2 \, dx$?

Solution:

We can move the 6 outside the integral:

$$\int 6x^2 \, dx = 6\int x^2 \, dx$$

And now use the Power Rule on x^2:

$$= 6\, x^3/\mathbf{3} + C$$

Simplify:

$$= 2x^3 + C$$

Example: What is $\int (8z + 4z^3 - 6z^2) \, dz$?

Solution:

Use the Sum and Difference Rule:

$$\int(8z + 4z^3 - 6z^2)\, dz = \int 8z\, dz + \int 4z^3\, dz - \int 6z^2\, dz$$

Constant Multiplication:

$$= 8\int z\, dz + 4\int z^3\, dz - 6\int z^2\, dz$$

Power Rule:

$$= 8z^2/2 + 4z^4/4 - 6z^3/3 + C$$

Simplify:

$$= 4z^2 + z^4 - 2z^3 + C$$

Example: What is $\int 6x^5 - 18x^2 + 7\, dx$

Solution:

$\int 6x^5 - 18x^2 + 7\, dx = 6(x^6/6) - 18\,(x^3/3) + 7x + C$

$\int 6x^5 - 18x^2 + 7\, dx = x^6 - 6x^3 + 7x + C$

Example: find the integral of the following function

$f(x) = 6x^8 - 20x^4 + x^2 + 9$

Solution:

$\int f(x)\, dx = \int [6x^8 - 20x^4 + x^2 + 9]\, dx$

$f(x) = (2/3)x^9 - 4x^5 + (1/3)x^3 + 9x + C$

Example: find the integral of the following function

$$\int (x+1)(x-2)\, dx = \int (x^2 - x - 2)\, dx$$

$$= \int x^2 dx - \int x dx - 2\int dx = \frac{1}{3}x^3 - \frac{1}{2}x^2 - 2x + c$$

Example: find the integral of the following function

$$\int \frac{1}{(2x-7)^6}.dx = \int (2x-7)^{-6}.dx$$

$$= \frac{(2x-7)^{-6+1}}{2(-6+1)} + c = \frac{-1}{10(2x-7)^5} + c$$

Example: find the integral of the following function

$$\int \sqrt[3]{x^2}\, dx = \int x^{\frac{2}{3}}\, dx = \frac{x^{\frac{2}{3}+1}}{\frac{2}{3}+1} + c = \frac{3}{5} x^{\frac{5}{3}} + c$$

Homework

Example: find the integral of the following functions

1- $f(x) = 6x^8 - 20x^4 + x^2 + 9$

2 – $\int$ **x3 + 5x + 6**