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Alevel Math

Unit: Integration A2

Contributed by Zunaira

Date:

Integration

Area under the curve

As

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + c$$

$$\int (ax+b)^n \, dx = \frac{(ax+b)^{n+1}}{a(n+1)} + c$$

$$\int_a^b f'(x) \, dx = f(x)\Big|_a^b$$

$$f(b) - f(a)$$

Rule of thumb

$$\int [f(x)]^n [f'(x)] \, dx$$

$$\frac{f(x)^{n+1}}{n+1} + c$$

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Integration of function

$$\int e^x dx = e^x + c$$

$$\int e^{ax} dx = \frac{1}{a} e^{ax} + c$$

for your refe

$$y = e^{ax}$$

$$\frac{dy}{dx} = ae^{ax}$$

$$\int dy = \int a e^{ax} dx$$

$$y = a\int e^{ax} dx$$

$$\frac{1}{a} y = \int e^{ax} dy$$

$$\frac{1}{a} e^{ax} = \int e^{ax} dy$$

$$\boxed{\int e^{ax} dx = \frac{1}{a} e^{ax}}$$

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Integration of $\frac{1}{ax+b}$

$\int \frac{1}{x}\,dx$ $\ln|x|+c$

$\int \frac{f'(x)}{f(x)}\,dx$ $\ln|f(x)|+c$

$\frac{1}{a}\int \frac{a}{ax+b}\,dx$

$\frac{1}{a}\ln|ax+b|+c$

Integration of trignometric functions:-

"Be sure that integration of $\sin^n$ & $\cos^n$ is not directly possible"

$\tan^n$

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$$\frac{d}{dx} \sin x = \cos x$$

$$\frac{d}{dx} \cos x = -\sin x$$

$$\frac{d}{dx} \tan x = \sec^2 x$$

$$\int d \sin x = \int \cos dx$$

$$\boxed{\int \cos x \, dx = \sin x + c}$$

$$\int d \cos x = -\int \sin x \, dx$$

$$\boxed{\int \sin x \, dx = -\cos x + c}$$

$$\int \frac{d}{dx} \tan x = \int \sec^2 x$$

$$\int d \tan x = \int \sec^2 x \, dx$$

$$\boxed{\int \sec^2 x \, dx = \tan x + c}$$

Except for these formulas, evaluation of integration is not possible directly by formula.

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$$\int \sin(ax+b)\,dx = -\frac{1}{a}\cos(ax+b)+C$$

$$\int \cos(ax+b)\,dx = \frac{1}{a}\sin(ax+b)+C$$

$$\int \sec^2(ax+b)\,dx = \frac{1}{a}\tan(ax+b)+C$$

Integration of tangent:-

$$\int \tan x\,dx$$

$$= -\int \frac{-\sin x}{\cos x}\,dx$$

$$= -\ln|\cos x| + C$$

Date:

Integration of

Sin / Cos with even power.

When ever Cos & Sin have an even power Always Apply.

$$\sin^2 A = \frac{1-\cos 2A}{2}$$ ✓

$$\cos^2 A = \frac{1+\cos 2A}{2}$$ ✓

Example :-

$$\int \sin^2 x \, dx$$

$$= \frac{1}{2}\int [1 - \cos 2x] \, dx$$

$$= \frac{1}{2}\int 1 \, dx - \frac{1}{2}\int \cos 2x \, dx.$$

$$= \frac{x}{2} - \frac{1}{4}\sin x + C.$$

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$$\int \sin^4 x\,dx$$

$$\int (\sin^2 x)^2\,dx$$

$$\cos^2 2x = \frac{1+\cos 4x}{2}$$

$$= \int \left[\frac{1-\cos 2x}{2}\right]^2 dx$$

$$= \frac{1}{4}\int [1-\cos 2x]^2\,dx$$

$$= \frac{1}{4}\int [1+\cos^2 2x - 2\cos 2x]\,dx$$

$$= \frac{1}{4}\int 1\,dx - \frac{2}{2\cdot 4}\int \cos 2x\,dx + \frac{1}{4}\int \cos^2 2x\,dx$$

$$= \frac{x}{4} - \frac{1}{8}\sin 2x + \frac{1}{4}\int \frac{1+\cos 4x}{2}\,dx$$

$$\frac{x}{4} - \frac{1}{4}\sin 2x + \frac{1}{2}\int dx + \frac{1}{8}\int \cos 4x\,dx$$

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$$= \frac{x}{4} - \frac{1}{4}\sin 2x + \frac{x}{2} + \frac{1}{32}\sin 4x$$

$$= \frac{3}{4}x - \frac{1}{4}\sin 2x + \frac{1}{32}\sin 4x + c$$

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