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Complete MATH

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Integrals

$$\frac{dy}{dx}\ (\phi(x)+C)=f(x)\Leftrightarrow\int f(x)\,dx=\phi(x)+c$$

where $\phi(x)$ is primitive of $f(x)$ and C is and arbitrary constant known as the constant of integration.

01. Some Standard Results

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

(ii) $\int\frac{dx}{ax+b}=\frac{1}{a}\ln(ax+b)+c$

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

(iv) $\int a^{px+q}dx=\frac{1}{p}\frac{a^{px+q}}{\ln a}(a>0)+c$

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

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

(vii) $\int\tan(ax+b)dx=\frac{1}{a}ln\sec(ax+b)+c$

(viii) $\int\cot(ax+b)dx=\frac{1}{a}ln\sin(ax+b)+c$

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

(x) $\int\text{cosec}^2(ax+b)dx=-\frac{1}{a}cot\ (ax+b)+c$

(xi) $\int\sec(ax+b)\tan(ax+b)dx=\frac{1}{a}sec(ax+b)+c$

(xii) $\int\text{cosec}(ax+b).\cot\ (ax+b)dx=-\frac{1}{a}cosec(ax+b)+c$

(xiii) $\int\sec x\ dx=\ln(\sec x+\tan x)+\cot\ln\left[\tan\left(\frac{\pi}{4}+\frac{x}{2}\right)\right]+c$

(xiv) $\int\text{cosec}\,x\ dx=\ln(\text{cosec}\,x-\cot x)+c$ or $\ln\left(\tan\frac{x}{2}\right)+c$ or $-\ln(\text{cosec}\,x+\cot x)+c$

(xv) $\int\sin hx\,dx=\cosh x+c$

(xvi) $\int\cos hx\,dx=\sin hx+c$

(xvii) $\int\sec h^2x dx=\tan hx+c$

(xviii) $\int\text{cosec}\,h^2x dx=-\cot hx+c$

(xix) $\int \operatorname{sech} x \cdot \tanh x \, dx = -\operatorname{sech} x + c$

(xx) $\int \operatorname{cosech} x \cdot \coth x \, dx = -\operatorname{cosech} x + c$

02. Techniques of Integration

(i) **Substitution or change of independent variable**

Integral $I = \int f(x)\,dx$ is changed to $\int f(\phi(x))\,\phi'(x)dx,$ by a suitable substitution $t = \phi(x)$ provided the later integral is easier to integrate.

(ii) $\int [f(x)]^n \, f'(x)\,dx$ or $\int \frac{f'(x)}{[f(x)]^n}\,dx$

Put $f(x) = t$ and proceed.

03. Some Special Integrals

(i) $\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\frac{x}{a} + c$

(ii) $\int \frac{dx}{a^2 + x^2} = \frac{1}{a}\tan^{-1}\frac{x}{a} + c$

(iii) $\int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{a} sec^{-1}\frac{x}{a} + c$

(iv) $\int \frac{dx}{\sqrt{x^2 + a^2}} = \ln\left[x + \sqrt{x^2 + a^2}\right] + c$

(v) $\int \frac{dx}{\sqrt{x^2 - a^2}} = \ln\left[x + \sqrt{x^2 - a^2}\right] + c$

(vi) $\int \frac{dx}{a^2 - x^2} = \frac{1}{2a} ln\left|\frac{a + x}{a - x}\right| + c$

(vii) $\int \frac{dx}{x^2 - a^2} = \frac{1}{2a} ln\left|\frac{x - a}{x + a}\right| + c$

(viii) $\int \sqrt{a^2 - x^2}\,dx = \frac{x}{2}\sqrt{a^2 - x^2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a} + c$

(ix) $\int \sqrt{x^2 + a^2}\,dx = \frac{x}{2}\sqrt{x^2 + a^2} + \frac{a^2}{2} sinh^{-1}\frac{x}{a} + c$

or $\frac{x}{2}\sqrt{x^2 + a^2} + \frac{a_2}{2} ln\left|x + \sqrt{x^2 + a^2}\right| + c$

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