Differentiation rules

General formulas

1、$\frac{d}{dx}(c)=0$

2、$\frac{d}{dx}[cf(x)]=cf'(x)$

3、$\frac{d}{dx}[f(x)+g(x)]=f'(x)+g'(x)$

4、$\frac{d}{dx}[f(x)-g(x)]=f'(x)-g'(x)$

5、$\frac{d}{dx}[f(x)g(x)]=f(x)g'(x)+f'(x)g(x)$ (Product Rule)

6、$\frac{d}{dx}[\frac{f(x)}{g(x)}]=\frac{g(x)f'(x)-f(x)g'(x)}{[g(x)]^2}$ (Quotient Rule)

7、$\frac{d}{dx}f(g(x))=f'(g(x))g'(x)$ (Chain Rule)

8、$\frac{d}{dx}(x^n)=nx^{n-1}$ (Power Rule)

Exponential and Logarithmic Functions

9、$\frac{d}{dx}(e^x)=e^x$

10、$\frac{d}{dx}(a^x)=a^x\ln a$

11、$\frac{d}{dx}\ln|x|=\frac{1}{x}$

12、$\frac{d}{dx}(\log_a x)=\frac{1}{x\ln a}$

Trigonometric Functions

13、$\frac{d}{dx}(\sin x)=\cos x$

14、$\frac{d}{dx}(\cos x)=-\sin x$

15、$\frac{d}{dx}(\tan x)=\sec^2 x$

16、$\frac{d}{dx}(\csc x)=-\csc x\cot x$

17、$\frac{d}{dx}(\sec x)=\sec x\tan x$

18、$\frac{d}{dx}(\cot x)=-\csc^2 x$

Inverse Trigonometric Functions

19、$\frac{d}{dx}(\sin^{-1}x)=\frac{1}{\sqrt{1-x^2}}$

20、$\frac{d}{dx}(\cos^{-1}x)=-\frac{1}{\sqrt{1-x^2}}$

21、$\frac{d}{dx}(\tan^{-1}x)=\frac{1}{1+x^2}$

22、$\frac{d}{dx}(\csc^{-1}x)=-\frac{1}{x\sqrt{x^2-1}}$

23、$\frac{d}{dx}(\sec^{-1}x)=\frac{1}{x\sqrt{x^2-1}}$

24、$\frac{d}{dx}(\cot^{-1}x)=-\frac{1}{1+x^2}$

Hyperbolic Functions

25、$\frac{d}{dx}(\sinh x)=\cosh x$

26、$\frac{d}{dx}(\cosh x)=\sinh x$

27、$\frac{d}{dx}(\tanh x)=\operatorname{sech}^2 x$

28、$\frac{d}{dx}(\operatorname{csch} x)=-\operatorname{csch} x\coth x$

29、$\frac{d}{dx}(\operatorname{sech} x)=-\operatorname{sech} x\tanh x$

30、$\frac{d}{dx}(\coth x)=-\operatorname{csch}^2 x$

Inverse Hyperbolic Functions

31、$\frac{d}{dx}(\sinh^{-1}x)=\frac{1}{\sqrt{1+x^2}}$

32、$\frac{d}{dx}(\cosh^{-1}x)=\frac{1}{\sqrt{x^2-1}}$

33、$\frac{d}{dx}(\tanh^{-1}x)=\frac{1}{1-x^2}$

34、$\frac{d}{dx}(\operatorname{csch}^{-1}x)=-\frac{1}{|x|\sqrt{x^2+1}}$

35、$\frac{d}{dx}(\operatorname{sech}^{-1}x)=-\frac{1}{x\sqrt{1-x^2}}$

36、$\frac{d}{dx}(\coth^{-1}x)=\frac{1}{1-x^2}$

Table of Integrals

Basic Forms

1、$\int udv=uv-\int vdu$

2、$\int u^n du=\frac{u^{n+1}}{n+1}+C$ ，$n\neq -1$

3、$\int\frac{du}{u}=\ln|u|+C$

4、$\int e^u du=e^u+C$

5、$\int a^u du=\frac{a^u}{\ln a}+C$

6、$\int\sin u du=-\cos u+C$

7、$\int\cos u du=\sin u+C$

8、$\int\sec^2 u du=\tan u+C$

9、$\int\csc^2 u du=-\cot u+C$

10、$\int\sec u\tan u du=\sec u+C$

11、$\int\csc u\cot u du=-\csc u+C$

12、$\int\tan u du=\ln|\sec u|+C$

13、$\int\cot u du=\ln|\sin u|+C$

14、$\int\sec u du=\ln|\sec u+\tan u|+C$

15、$\int\csc u du=\ln|\csc u-\cot u|+C$

16、$\int\frac{du}{\sqrt{a^2-u^2}}=\sin^{-1}\frac{u}{a}+C$

17、$\int\frac{du}{a^2+u^2}=\frac{1}{a}\tan^{-1}\frac{u}{a}+C$

18、$\int\frac{du}{u\sqrt{u^2-a^2}}=\frac{1}{a}\sec^{-1}\frac{u}{a}+C$

19、$\int\frac{du}{a^2-u^2}=\frac{1}{2a}\ln\left|\frac{u+a}{u-a}\right|+C$

20、$\int\frac{du}{u^2-a^2}=\frac{1}{2a}\ln\left|\frac{u-a}{u+a}\right|+C$

Forms Involving $\sqrt{a^2+u^2}$ ，$a>0$

21、$\int\sqrt{a^2+u^2}du=\frac{u}{2}\sqrt{a^2+u^2}+\frac{a^2}{2}\ln(u+\sqrt{a^2+u^2})+C$

22、$\int u^2\sqrt{a^2+u^2}du=\frac{u}{8}(a^2+2u^2)\sqrt{a^2+u^2}-\frac{a^4}{8}\ln(u+\sqrt{a^2+u^2})+C$

23、 $\int \frac{\sqrt{a^2+u^2}}{u}du = \sqrt{a^2+u^2} - a\ln\left|\frac{a+\sqrt{a^2+u^2}}{u}\right| + C$

24、 $\int \frac{\sqrt{a^2+u^2}}{u^2}du = -\frac{\sqrt{a^2+u^2}}{u} + \ln(u+\sqrt{a^2+u^2}) + C$

25、 $\int \frac{du}{\sqrt{a^2+u^2}} = \ln(u+\sqrt{a^2+u^2}) + C$

26、 $\int \frac{u^2du}{\sqrt{a^2+u^2}} = \frac{u}{2}\sqrt{a^2+u^2} - \frac{a^2}{2}\ln(u+\sqrt{a^2+u^2}) + C$

27、 $\int \frac{du}{u\sqrt{a^2+u^2}} = -\frac{1}{a}\ln\left|\frac{\sqrt{a^2+u^2}+a}{u}\right| + C$

28、 $\int \frac{du}{u^2\sqrt{a^2+u^2}} = -\frac{\sqrt{a^2+u^2}}{a^2u} + C$

29、 $\int \frac{du}{(a^2+u^2)^{3/2}} = \frac{u}{a^2\sqrt{a^2+u^2}} + C$

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Forms Involving $\sqrt{a^2-u^2}$ ， $a>0$

30、 $\int \sqrt{a^2-u^2}du = \frac{u}{2}\sqrt{a^2-u^2} + \frac{a^2}{2}\sin^{-1}\frac{u}{a} + C$

31、 $\int u^2\sqrt{a^2-u^2}du = \frac{u}{8}(2u^2-a^2)\sqrt{a^2-u^2} + \frac{a^4}{8}\sin^{-1}\frac{u}{a} + C$

32、 $\int \frac{\sqrt{a^2-u^2}}{u}du = \sqrt{a^2-u^2} - a\ln\left|\frac{a+\sqrt{a^2-u^2}}{u}\right| + C$

33、 $\int \frac{\sqrt{a^2-u^2}}{u^2}du = -\frac{\sqrt{a^2-u^2}}{u} - \sin^{-1}\frac{u}{a} + C$

34、 $\int \frac{u^2du}{\sqrt{a^2-u^2}} = -\frac{u}{2}\sqrt{a^2-u^2} + \frac{a^2}{2}\sin^{-1}\frac{u}{a} + C$

35、 $\int \frac{du}{u\sqrt{a^2-u^2}} = -\frac{1}{a}\ln\left|\frac{a+\sqrt{a^2-u^2}}{u}\right| + C$

36、 $\int \frac{du}{u^2\sqrt{a^2-u^2}} = -\frac{\sqrt{a^2-u^2}}{a^2u} + C$

37、 $\int (a^2-u^2)^{3/2}du = -\frac{u}{8}(2u^2-5a^2)\sqrt{a^2-u^2} + \frac{3a^4}{8}\sin^{-1}\frac{u}{a} + C$

38、 $\int \frac{du}{(a^2-u^2)^{3/2}} = \frac{u}{a^2\sqrt{a^2-u^2}} + C$

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Forms Involving $\sqrt{u^2-a^2}$ ， $a>0$

39、 $\int \sqrt{u^2-a^2}du = \frac{u}{2}\sqrt{u^2-a^2} - \frac{a^2}{2}\ln\left|u+\sqrt{u^2-a^2}\right| + C$

40、 $\int u^2\sqrt{u^2-a^2}du = \frac{u}{8}(2u^2-a^2)\sqrt{u^2-a^2} - \frac{a^4}{8}\ln\left|u+\sqrt{u^2-a^2}\right| + C$

41、 $\int \frac{\sqrt{u^2-a^2}}{u}du = \sqrt{u^2-a^2} - a\cos^{-1}\frac{a}{|u|} + C$

42、 $\int \frac{\sqrt{u^2-a^2}}{u^2}du = -\frac{\sqrt{u^2-a^2}}{u} + \ln\left|u+\sqrt{u^2-a^2}\right| + C$

43、 $\int \frac{du}{\sqrt{u^2-a^2}} = \ln\left|u+\sqrt{u^2-a^2}\right| + C$

44、 $\int \frac{u^2du}{\sqrt{u^2-a^2}} = \frac{u}{2}\sqrt{u^2-a^2} + \frac{a^2}{2}\ln\left|u+\sqrt{u^2-a^2}\right| + C$

45、 $\int \frac{du}{u^2\sqrt{u^2-a^2}} = \frac{\sqrt{u^2-a^2}}{a^2u} + C$

46、 $\int \frac{du}{(u^2-a^2)^{3/2}} = -\frac{u}{a^2\sqrt{u^2-a^2}} + C$

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Forms Involving $a+bu$

47、 $\int \frac{udu}{a+bu} = \frac{1}{b^2}(a+bu-a\ln|a+bu|) + C$

48、 $\int \frac{u^2du}{a+bu} = \frac{1}{2b^3}[(a+bu)^2 - 4a(a+bu) + 2a^2\ln|a+bu|] + C$

49、 $\int \frac{du}{u(a+bu)} = \frac{1}{a}\ln\left|\frac{u}{a+bu}\right| + C$

50、 $\int \frac{du}{u^2(a+bu)} = -\frac{1}{au} + \frac{b}{a^2}\ln\left|\frac{a+bu}{u}\right| + C$

51、 $\int \frac{udu}{(a+bu)^2} = \frac{a}{b^2(a+bu)} + \frac{1}{b^2}\ln|a+bu| + C$

52、 $\int \frac{du}{u(a+bu)^2} = \frac{1}{a(a+bu)} - \frac{1}{a^2}\ln\left|\frac{a+bu}{u}\right| + C$

53、$\int \frac{u^2 du}{(a+bu)^2} = \frac{1}{b^3}\left(a+bu - \frac{a^2}{a+bu} - 2a\ln|a+bu|\right)+C$

54、$\int u\sqrt{a+bu}\,du = \frac{2}{15b^2}(3bu-2a)(a+bu)^{3/2}+C$

55、$\int \frac{u\,du}{\sqrt{a+bu}} = \frac{2}{3b^2}(bu-2a)\sqrt{a+bu}+C$

56、$\int \frac{u^2 du}{\sqrt{a+bu}} = \frac{2}{15b^3}(8a^2+3b^2u^2-4abu)\sqrt{a+bu}+C$

57、$\int \frac{du}{u\sqrt{a+bu}} = \frac{1}{\sqrt{a}}\ln\left|\frac{\sqrt{a+bu}-\sqrt{a}}{\sqrt{a+bu}+\sqrt{a}}\right|+C$，if $a>0$

$= \frac{2}{\sqrt{-a}}\tan^{-1}\sqrt{\frac{a+bu}{-a}}+C$，if $a<0$

58、$\int \frac{\sqrt{a+bu}}{u}du = 2\sqrt{a+bu} + a\int \frac{du}{u\sqrt{a+bu}}$

59、$\int \frac{\sqrt{a+bu}}{u^2}du = -\frac{\sqrt{a+bu}}{u} + \frac{b}{2}\int \frac{du}{u\sqrt{a+bu}}$

60、$\int u^n\sqrt{a+bu}\,du = \frac{2}{b(2n+3)}[u^n(a+bu)^{3/2} - na\int u^{n-1}\sqrt{a+bu}\,du]$

61、$\int \frac{u^n du}{\sqrt{a+bu}} = \frac{2u^n\sqrt{a+bu}}{b(2n+1)} - \frac{2na}{b(2n+1)}\int \frac{u^{n-1}du}{\sqrt{a+bu}}$

62、$\int \frac{du}{u^n\sqrt{a+bu}} = -\frac{\sqrt{a+bu}}{a(n-1)u^{n-1}} - \frac{b(2n-3)}{2a(n-1)}\int \frac{du}{u^{n-1}\sqrt{a+bu}}$

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Trigonometric Forms

63、$\int \sin^2 u\,du = \frac{1}{2}u - \frac{1}{4}\sin 2u + C$

64、$\int \cos^2 u\,du = \frac{1}{2}u + \frac{1}{4}\sin 2u + C$

65、$\int \tan^2 u\,du = \tan u - u + C$

66、$\int \cot^2 u\,du = -\cot u - u + C$

67、$\int \sin^3 u\,du = -\frac{1}{3}(2+\sin^2 u)\cos u + C$

68、$\int \cos^3 u\,du = \frac{1}{3}(2+\cos^2 u)\sin u + C$

69、$\int \tan^3 u\,du = \frac{1}{2}\tan^2 u + \ln|\cos u| + C$

70、$\int \cot^3 u\,du = -\frac{1}{2}\cot^2 u - \ln|\sin u| + C$

71、$\int \sec^3 u\,du = \frac{1}{2}\sec u\tan u + \frac{1}{2}\ln|\sec u + \tan u| + C$

72、$\int \csc^3 u\,du = -\frac{1}{2}\csc u\cot u + \frac{1}{2}\ln|\csc u - \cot u| + C$

73、$\int \sin^n u\,du = -\frac{1}{n}\sin^{n-1}u\cos u + \frac{n-1}{n}\int \sin^{n-2}u\,du$

74、$\int \cos^n u\,du = \frac{1}{n}\cos^{n-1}u\sin u + \frac{n-1}{n}\int \cos^{n-2}u\,du$

75、$\int \tan^n u\,du = \frac{1}{n-1}\tan^{n-1}u - \int \tan^{n-2}u\,du$

76、$\int \cot^n u\,du = \frac{-1}{n-1}\cot^{n-1}u - \int \cot^{n-2}u\,du$

77、$\int \sec^n u\,du = \frac{1}{n-1}\tan u\sec^{n-2}u + \frac{n-2}{n-1}\int \sec^{n-2}u\,du$

78、$\int \csc^n u\,du = \frac{-1}{n-1}\cot u\csc^{n-2}u + \frac{n-2}{n-1}\int \csc^{n-2}u\,du$

79、$\int \sin au\sin bu\,du = \frac{\sin(a-b)u}{2(a-b)} - \frac{\sin(a+b)u}{2(a+b)} + C$

80、$\int \cos au\cos bu\,du = \frac{\sin(a-b)u}{2(a-b)} + \frac{\sin(a+b)u}{2(a+b)} + C$

81、$\int \sin au\cos bu\,du = -\frac{\cos(a-b)u}{2(a-b)} - \frac{\cos(a+b)u}{2(a+b)} + C$

82、$\int u\sin u\,du = \sin u - u\cos u + C$

83、$\int u\cos u\,du = \cos u + u\sin u + C$

84、$\int u^n\sin u\,du = -u^n\cos u + n\int u^{n-1}\cos u\,du$

85、$\int u^n\cos u\,du = u^n\sin u - n\int u^{n-1}\sin u\,du$

86、$\int \sin^n u\cos^m u\,du = -\frac{\sin^{n-1}u\cos^{m+1}u}{n+m} + \frac{n-1}{n+m}\int \sin^{n-2}u\cos^m u\,du$

$= \frac{\sin^{n+1}u\cos^{m-1}u}{n+m} + \frac{m-1}{n+m}\int \sin^n u\cos^{m-2}u\,du$

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Inverse Trigonometric Forms

87、$\int \sin^{-1}u\,du = u\sin^{-1}u + \sqrt{1-u^2} + C$

88、$\int \cos^{-1}u\,du = u\cos^{-1}u - \sqrt{1-u^2} + C$

89、$\int \tan^{-1}u\,du = u\tan^{-1}u - \frac{1}{2}\ln(1+u^2) + C$

90、$\int u\sin^{-1}u\,du = \frac{2u^2-1}{4}\sin^{-1}u + \frac{u\sqrt{1-u^2}}{4} + C$

91、$\int u\cos^{-1}u\,du = \frac{2u^2-1}{4}\cos^{-1}u - \frac{u\sqrt{1-u^2}}{4} + C$

92、$\int u\tan^{-1}u\,du = \frac{u^2+1}{2}\tan^{-1}u - \frac{u}{2} + C$

93、$\int u^n\sin^{-1}u\,du = \frac{1}{n+1}[u^{n+1}\sin^{-1}u - \int \frac{u^{n+1}du}{\sqrt{1-u^2}}]$，$n \neq -1$

94、$\int u^n\cos^{-1}u\,du = \frac{1}{n+1}[u^{n+1}\cos^{-1}u + \int \frac{u^{n+1}du}{\sqrt{1-u^2}}]$，$n \neq -1$

95、$\int u^n\tan^{-1}u\,du = \frac{1}{n+1}[u^{n+1}\tan^{-1}u - \int \frac{u^{n+1}du}{1+u^2}]$，$n \neq -1$

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Exponential and Logarithmic Forms

96、 $\int ue^{au}du = \frac{1}{a^2}(au-1)e^{au} + C$

97、 $\int u^n e^{au}du = \frac{1}{a}u^n e^{au} - \frac{n}{a}\int u^{n-1}e^{au}du$

98、 $\int e^{au}\sin bu du = \frac{e^{au}}{a^2+b^2}(a\sin bu - b\cos bu) + C$

99、 $\int e^{au}\cos bu du = \frac{e^{au}}{a^2+b^2}(a\cos bu + b\sin bu) + C$

100、 $\int \ln u du = u\ln u - u + C$

101、 $\int u^n \ln u du = \frac{u^{n+1}}{(n+1)^2}[(n+1)\ln u - 1] + C$

102、 $\int \frac{1}{u\ln u}du = \ln|\ln u| + C$

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Hyperbolic Forms

103、 $\int \sinh u du = \cosh u + C$

104、 $\int \cosh u du = \sinh u + C$

105、 $\int \tanh u du = \ln\cosh u + C$

106、 $\int \coth u du = \ln|\sinh u| + C$

107、 $\int \operatorname{sech} u du = \tan^{-1}|\sinh u| + C$

108、 $\int \operatorname{csch} u du = \ln\left|\tanh\frac{1}{2}u\right| + C$

109、 $\int \operatorname{sech}^2 u du = \tanh u + C$

110、 $\int \operatorname{csch}^2 u du = -\coth u + C$

111、 $\int \operatorname{sech} u \tanh u du = -\operatorname{sech} u + C$

112、 $\int \operatorname{csch} u \coth u du = -\operatorname{csch} u + C$

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Forms Involving $\sqrt{2au-u^2}$ ， $a>0$

113、 $\int \sqrt{2au-u^2}du = \frac{u-a}{2}\sqrt{2au-u^2} + \frac{a^2}{2}\cos^{-1}(\frac{a-u}{a}) + C$

114、 $\int u\sqrt{2au-u^2}du = \frac{2u^2-au-3a^2}{6}\sqrt{2au-u^2} + \frac{a^3}{2}\cos^{-1}(\frac{a-u}{a}) + C$

115、 $\int \frac{\sqrt{2au-u^2}}{u}du = \sqrt{2au-u^2} + a\cos^{-1}(\frac{a-u}{a}) + C$

116、 $\int \frac{\sqrt{2au-u^2}}{u^2}du = -\frac{2\sqrt{2au-u^2}}{u} - \cos^{-1}(\frac{a-u}{a}) + C$

117、 $\int \frac{du}{\sqrt{2au-u^2}} = \cos^{-1}(\frac{a-u}{a}) + C$

118、 $\int \frac{udu}{\sqrt{2au-u^2}} = -\sqrt{2au-u^2} + a\cos^{-1}(\frac{a-u}{a}) + C$

119、 $\int \frac{u^2du}{\sqrt{2au-u^2}} = -\frac{(u+3a)}{2}\sqrt{2au-u^2} + \frac{3a^2}{2}\cos^{-1}(\frac{a-u}{a}) + C$

120、 $\int \frac{du}{u\sqrt{2au-u^2}} = -\frac{\sqrt{2au-u^2}}{au} + C$