DERIVATIVES

I Basic rules

1. The derivative of constant multiple is equal to the constant multiple of derivative

$$(cf(x))' = cf'(x), \quad c \in \mathbb{R}.$$

2. The derivative of sum is equal to the sum of derivatives

$$(f(x) + g(x))' = f'(x) + g'(x).$$

3. Product Rule (the derivative of product is equal to the derivative of the first times the second plus the first times the derivative of the second)

$$(f(x) \cdot g(x))' = f'(x)g(x) + f(x)g'(x).$$

4. Quotient Rule (the derivative of fraction is equal to the derivative of numerator times denominator minus numerator times the derivative of denominator, over denominator squared)

$$\left(\frac{f(x)}{g(x)}\right)' = \frac{f'(x)g(x) - f(x)g'(x)}{[g(x)]^2}.$$

5. Chain Rule (the derivative of composite function is equal to the derivative of the outer function times the the derivative of the inner function)

$$[f(g(x))]' = f'(g(x)) \cdot g'(x).$$

II Derivatives of basic functions

1. $(c)' = 0, \quad c \in \mathbb{R}$

2. $(ax + b)' = a, \quad a, b \in \mathbb{R}$

3. $\left(\dfrac{1}{x}\right)' = -\dfrac{1}{x^2}$

4. $\left(\sqrt{x}\right)' = \dfrac{1}{2\sqrt{x}}$

5. $(x^s)' = sx^{s-1}, \quad s \in \mathbb{R}$

6. $(\sin x)' = \cos x$

7. $(\cos x)' = -\sin x$

8. $(\tan x)' = \dfrac{1}{\cos^2 x}$

9. $(\cot x)' = -\dfrac{1}{\sin^2 x}$

10. $(e^x)' = e^x$

11. $(a^x)' = a^x \ln a, \quad a > 0$

12. $(\ln x)' = \dfrac{1}{x}$

13. $(\log_a x)' = \dfrac{1}{x \ln a}, \quad a > 0, a \neq 1$

14. $(\arcsin x)' = \dfrac{1}{\sqrt{1 - x^2}}$

15. $(\arccos x)' = -\dfrac{1}{\sqrt{1 - x^2}}$

16. $(\arctan x)' = \dfrac{1}{1 + x^2}$

17. $(\operatorname{arccot} x)' = -\dfrac{1}{1 + x^2}$

18. $(\sinh x)' = \cosh x$

19. $(\cosh x)' = \sinh x$

20. $(\tanh x)' = \dfrac{1}{\cosh^2 x}$

21. $(\coth x)' = -\dfrac{1}{\sinh^2 x}$