Calculus I

– Formulas in a Nutshell –

Derivatives

1. $f'(x) = \lim_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$

2. **Equation of Tangent Line to $f(x)$ at $x = a$:** $y = f'(a)(x-a) + f(a)$

3. **Constant Multiple:**
$\dfrac{d}{dx}\left(cf(x)\right) = c\left(\dfrac{d}{dx}f(x)\right)$

4. **Sum/Difference Rule:**
$\dfrac{d}{dx}\left(f(x) \pm g(x)\right) = f'(x) \pm g'(x)$

5. **Power Rule:**
$\dfrac{d}{dx}\left(x^n\right) = nx^{n-1}$

6. **Product Rule:**
$\dfrac{d}{dx}\left(f(x)g(x)\right) = f(x)g'(x) + f'(x)g(x)$

7. **Quotient Rule:**
$\dfrac{d}{dx}\left(\dfrac{f(x)}{g(x)}\right) = \dfrac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$

8. **Chain Rule:**
$\dfrac{d}{dx}\left(f(g(x))\right) = f'(g(x))g'(x)$

9. $\dfrac{d}{dx}\left(e^x\right) = e^x$

10. $\dfrac{d}{dx}\left(a^x\right) = \left(\ln a\right)a^x$

11. $\dfrac{d}{dx}\ln(x) = \dfrac{1}{x}$

12. $\dfrac{d}{dx}\sin(x) = \cos(x)$

13. $\dfrac{d}{dx}\cos(x) = -\sin(x)$

14. $\dfrac{d}{dx}\tan(x) = \sec^2(x)$

15. $\dfrac{d}{dx}\sec(x) = \sec(x)\tan(x)$

16. $\dfrac{d}{dx}\csc(x) = -\csc(x)\cot(x)$

17. $\dfrac{d}{dx}\cot(x) = -\csc^2(x)$

18. $\dfrac{d}{dx}\arcsin(x) = \dfrac{1}{\sqrt{1-x^2}}$

19. $\dfrac{d}{dx}\arccos(x) = \dfrac{-1}{\sqrt{1-x^2}}$

20. $\dfrac{d}{dx}\arctan(x) = \dfrac{1}{1+x^2}$

21. $\dfrac{d}{dx}\sinh(x) = \cosh(x)$

22. $\dfrac{d}{dx}\cosh(x) = \sinh(x)$

23. **L'Hôpital's Rule:**
If f, g are differentiable and $f(a) = g(a) = 0$,
then $\lim_{x \to a} \dfrac{f(x)}{g(x)} = \lim_{x \to a} \dfrac{f'(x)}{g'(x)}$

Integrals

1. **Fundamental Theorem of Calculus:**
   If f is continuous on $[a, b]$ and $f(x) = F'(x)$, then $\int_a^b f(x)dx = F(x)\Big|_a^b = F(b) - F(a)$

2. $\int_a^b f(x)dx = -\int_b^a f(x)dx$

3. $\int_a^c f(x)dx + \int_c^b f(x)dx = \int_a^b f(x)dx$

4. **Constant Multiple:**
   $\int_a^b cf(x)dx = c\int_a^b f(x)dx$

5. **Sum/Difference Rule:**
   $\int_a^b (f(x) \pm g(x))\,dx = \int_a^b f(x)dx \pm \int_a^b g(x)dx$

6. **Average Value of f from a to b:**
   $\frac{1}{b-a}\int_a^b f(x)dx$

7. **Power Rule:**
   $\int x^n dx = \frac{x^{n+1}}{n+1} + C$, if $n \neq -1$

8. **Constant Multiple:**
   $\int cf(x)dx = c\int f(x)dx$

9. **Sum/Difference Rule:**
   $\int (f(x) \pm g(x))\,dx = \int f(x)dx \pm \int g(x)dx$

10. $\int \frac{1}{x}dx = \ln|x| + C$

11. $\int e^x dx = e^x + C$

12. $\int \sin(x)dx = -\cos(x) + C$

13. $\int \cos(x)dx = \sin(x) + C$