Some useful formulas

1. $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$

2. $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$

3. $\sum_{i=1}^{n} i^3 = (\sum_{i=1}^{n} i)^2$

4. $\sum_{i=0}^{k} 2^i = 2^{k+1} - 1$

5. $\sum_{i=0}^{k} \frac{1}{2^i} = 2$ when k tends to infinity.

6. $\sum_{i=0}^{n} x^i = \frac{x^{n+1}-1}{x-1}$ $x \neq 1$

7. If $|x| < 1$ then $\lim_{n \to \infty} \sum_{k=0}^{n} x^k = \frac{1}{1-x}$

8. $\sum_{i=0}^{n} i x^i = \frac{1}{(1-x)^2}$ If $|x| < 1$

Harmonic series

9. $Hn = \sum_{k=1}^{n} \frac{1}{k} = 1 + \frac{1}{2} + \frac{1}{3} + ... + \frac{1}{n} = \ln n + O(1)$

10. If T(n) = a T $(\frac{n}{b})$ + $O(n^d)$ with a$>$ 0 , $b > 1, d \geq 0$, then

$$T(n) = \begin{cases} O(n^d) & \text{if } d > \log_b a \\ O(n^d \log_b n) & \text{if } d = \log_b a \\ O(n^{\log_b a}) & \text{if } d < \log_b a \end{cases}$$

11. $\log(ab) = \log(a) + \log(b)$
12. $\log(\frac{a}{b}) = \log(a) - \log(b)$
13. $\log(a^b) = b \log a$
14. $\log_b(a) = \frac{\ln(a)}{\ln(b)}$
15. $a^{\log_b(n)} = n^{\log_b(a)}$