Algorithm Summation Cheat Sheet

1.
$$\sum_{i=l}^{u} 1 = u - l + 1$$

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

3.
$$\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6} \approx \frac{1}{3}n^3 \in \Theta(n^3)$$

4.
$$\sum_{i=1}^{n} i^k \approx \frac{1}{k+1}n^{k+1} \Rightarrow \Theta(n^{k+1})$$

5.
$$\sum_{i=0}^{n} a^i = \frac{a^{n+1} - 1}{a - 1} \qquad (a \neq 1)$$

6.
$$\sum_{i=1}^{n} i2^i = (n-1)2^{n+1} + 2$$

7.
$$\sum_{i=1}^{n} \frac{1}{i} \approx \ln n + \gamma \qquad (\gamma \approx 0.5772) \in \Theta(\log n)$$

8.
$$\sum_{i=1}^{n} \log i \approx n \log n \in \Theta(n \log n)$$

Note: In algorithm analysis, exact formulas are often replaced with Θ notation once the dominant term becomes clear. This focuses on how the function grows as n becomes large.