$$\sum k = \frac{n(n+1)}{2}$$

$$\sum k^2 = \frac{n(n+1)(2n+1)}{6}$$

$$\sum k^3 = \left(\frac{n(n+1)}{2}\right)^2$$

$$\sum k(k+1) = \frac{n(n+1)(n+2)}{3}$$

$$\sum k(k+1) = \sum k^2 + \sum k$$

$$= \frac{n(n+1)(2n+1)}{6} + \frac{n(n+1)}{6}$$

$$= \frac{n(n+1)(2n+1+3)}{6}$$

$$= \frac{n(n+1)(n+2)}{3}$$