Each of the six boxes shown in the equation below is replaced with a distinct number chosen from $\{1, 2, 3, \ldots, 27\}$.
$$S = \frac{\square}{\square} + \frac{\square}{\square} + \frac{\square}{\square}.$$

Suppose that the order of the fractions doesn't matter. Then there is exactly one way to arrange six numbers into the boxes such that $S < 1$ and S is as large as possible. Compute the sum of the 6 numbers.