23. Given four different non-zero digits, it is possible to form 24 different four-digit numbers containing each of these four digits. What is the largest prime factor of the sum of the 24 numbers?

A 23 B 93 C 97 D 101 E 113

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23. D Let a four-digit positive integer be expressed as $1000a + 100b + 10c + d$ where a, b, c and d are all different. In the 24 possible permutations of a, b, c and d, each of the four letters appears in each position six times. Adding all 24 numbers together gives $1000(6a+6b+6c+6d) + 100(6a+6b+6c+6d) + 10(6a+6b+6c+6d) + 6a+6b+6c+6d$. The total is therefore $1111 \times 6(a+b+c+d)$ which factorises to $2 \times 3 \times 11 \times 101(a+b+c+d)$. As $a+b+c+d < 101$, the largest prime factor of the sum is 101.