Exercise 1. Show that for $\Re(s) > 1$, the logarithmic derivative of the Riemann zeta function is
\[
-\frac{\zeta'(s)}{\zeta(s)} = \sum_{n=1}^{\infty} \frac{\Lambda(n)}{n^s}
\]
where the von Mangoldt function $\Lambda(n) = \log p$, if $n = p^k$ is a prime power, and 0 otherwise.

Exercise 2. Find the character table of $(\mathbb{Z}/12\mathbb{Z})^*$.

Exercise 3. For $q > 2$, let $\chi_0$ be the principal character mod $q$. The associated L-function $L(s, \chi_0)$ has a simple pole at $s = 1$. Compute its residue at $s = 1$. 