

How many digits are in the product $4^5 \cdot 5^{10}$?

We can rewrite the product as

$$\begin{aligned}4^5 \cdot 5^{10} &= (2^2)^5 \cdot 5^{10} \\ &= 2^{10} \cdot 5^{10} \\ &= 10^{10}\end{aligned}$$

which has 11 digits (10 zeroes and the initial 1)

Note the use of the index Laws:

$$(a^b)^c = a^{bc}$$

$$a^c \cdot b^c = (ab)^c$$