

Let x, y, w, z be whole numbers.

If $2^w \cdot 3^x \cdot 5^y \cdot 7^z = 588$ then what does $2w + 3x + 5y + 7z$ equal?

First we write out the prime factorisation of 588:

$$\begin{aligned} 588 &= 2 \times 294 \\ &= 2^2 \times 147 \\ &= 2^2 \times 3 \times 49 \\ &= 2^2 \times 3 \times 7^2 \end{aligned}$$

Hence

$$\begin{aligned} w &= 2 \\ x &= 1 \\ y &= 0 \\ z &= 2 \end{aligned}$$

and we have

$$2w + 3x + 5y + 7z = 4 + 3 + 0 + 14$$

$$= 21$$