$$\lim_{n\to\infty}\left[x^n+y^n\right]^{\frac{m}{n}}=\left[max\{x,y\}\right]^m \qquad \forall x,y\geq 0$$

Proof:
Assume, without loss of generality, that $x > y$. Then,

$$\lim_{n\to\infty}\left[x^n+y^n\right]^{\frac{m}{n}}=\lim_{n\to\infty}\left[\sqrt[n]{x^n+y^n}\right]^m=\left[\lim_{n\to\infty}\sqrt[n]{x^n+y^n}\right]^m$$

Now, we only need to worry about the inner limit, then we'll come back and take the result to the m-th power. We can do this because the m is not affected by our limit, and so does not affect what the limit inside evaluates to.

We now have this

$$\lim_{n\to\infty}\sqrt[n]{x^n+y^n}$$

If we factor out an x^n on the inside, we get

$$\lim_{n\to\infty}\sqrt[n]{x^n\left[1+\left(\frac{y}{x}\right)^n\right]}=\lim_{n\to\infty}x\sqrt[n]{1+\left(\frac{y}{x}\right)^n}=x\cdot\lim_{n\to\infty}\sqrt[n]{1+\left(\frac{y}{x}\right)^n}$$

Let's remove the x for now, since it isn't affected by our limit, and analyze what's left.

Since x and y are non-negative, we know that $\sqrt[n]{1}\leq\sqrt[n]{1+\left(\frac{y}{x}\right)^n}$, because $1\leq 1+\left(\frac{y}{x}\right)^n$ and $\sqrt[n]{1+\left(\frac{y}{x}\right)^n}\leq 1+\left(\frac{y}{x}\right)^n$ since $a^n\geq a$ for $a\geq 0$ and $n>1$.

$$\sqrt[n]{1}\leq\sqrt[n]{1+\left(\frac{y}{x}\right)^n}\leq 1+\left(\frac{y}{x}\right)^n$$

Taking the limit as $n\to\infty$, we find that

$$\lim_{n\to\infty}\sqrt[n]{1}=1\leq\lim_{n\to\infty}\sqrt[n]{1+\left(\frac{y}{x}\right)^n}\leq 1+\left(\frac{y}{x}\right)^n=1$$

The last equality holds because, since $x > y$, $\frac{y}{x} < 1$, and so $\left(\frac{y}{x}\right)^n \to 0$ as $n \to \infty$. Now let's multiply everything by x. We now have

$$x \leq \lim_{n\to\infty} x \cdot \sqrt[n]{1 + \left(\frac{y}{x}\right)^n} = \lim_{n\to\infty} \sqrt[n]{x^n \left[1 + \left(\frac{y}{x}\right)^n\right]} = \lim_{n\to\infty} \sqrt[n]{x^n + y^n} \leq x$$

Since we have that our limit is less than or equal to and greater than or equal to x, it must be equal to x, by the Squeeze Theorem.

$$\lim_{n\to\infty} \sqrt[n]{x^n + y^n} = x$$

Because we chose to look at this where $x > y$, we can apply to the same logic, but instead with y, and find this limit equal to y when $y > x$, which means the limit depends on which term is greater. Therefore,

$$\lim_{n\to\infty} \sqrt[n]{x^n + y^n} = max\{x, y\}$$

We have one more step to finally prove our proposition. We will take this limit to the m-th power.

$$\left[\lim_{n\to\infty} \sqrt[n]{x^n + y^n}\right]^m = \lim_{n\to\infty} \sqrt[n]{x^n + y^n}^m = \lim_{n\to\infty} (x^n + y^n)^{\frac{m}{n}} = (max\{x, y\})^m$$

QED