Example 1 Simplify $(3^{\pi})^4$

$$(3^{\pi})^4 = 3^{4\pi} = (3^4)^{\pi} = \boxed{\mathbf{81^{\pi}}}$$

Example 2 Simplify $\sqrt{7^{4\pi}}$

Let's convert this from radical form to exponential form.

$$\sqrt{7^{4\pi}} = (7^{4\pi})^{1/2} = 7^{4\pi \cdot 1/2} = 7^{2\pi} = (7^2)^{\pi} = \boxed{\mathbf{49^{\pi}}}$$

When we multiply or divide, we want to have the SAME BASES.

Example 3 Simplify $\frac{2^{\sqrt{5}+4}}{2^{\sqrt{5}-2}}$

The bases are the same (they are both 2), so we can follow the exponent rules for dividing (we will subtract the exponents)

$$\frac{2^{\sqrt{5}+4}}{2^{\sqrt{5}-2}} = 2^{\sqrt{5}+4-(\sqrt{5}-2)} = 2^{\sqrt{5}+4-\sqrt{5}+2} = 2^6 = \boxed{\mathbf{64}}$$

Example 4 Simplify $(\sqrt{5})^{\sqrt{3}}(\sqrt{5})^{-\sqrt{3}}$

The bases are the same (they are both $\sqrt{5}$), so we can follow the exponent rules for multiplying (we will add the exponents)

$$(\sqrt{5})^{\sqrt{3}}(\sqrt{5})^{-\sqrt{3}} = (\sqrt{5})^{\sqrt{3}+(-\sqrt{3})} = (\sqrt{5})^0 = \boxed{\mathbf{1}}$$

Remember, when we multiply or divide, we want to have the SAME BASES.

Example 5 Simplify $9^{-3.2} \bullet 3^{3.4}$

Our bases are not the same. One of them is 9 and the other one is 3. Are these numbers (9 and 3) powers of the same number? Yes! We know 9 (3^2) and 3 (3^1) are both powers of the number **3**. We will rewrite our expression so the bases are both **3**.

$$9^{-3.2} \bullet 3^{3.4} = (3^2)^{-3.2} \bullet 3^{3.4} = 3^{-6.4} \bullet 3^{3.4} = 3^{-3.0} = 3^{-3} = \frac{1}{3^3} = \boxed{\mathbf{\frac{1}{27}}}$$

Example 6 Simplify $\frac{8^{2.8}}{4^{3.2}}$

Our bases are not the same. One of them is 8 and the other one is 4. Are these numbers (8 and 4) powers of the same number? Yes! We know 8 (2^3) and 4 (2^2) are both powers of the number **2**. We will rewrite our expression so the bases are both **2**.

$$\frac{8^{2.8}}{4^{3.2}} = \frac{(2^3)^{2.8}}{(2^2)^{3.2}} = \frac{2^{8.4}}{2^{6.4}} = 2^{8.4-6.4} = 2^2 = \boxed{\mathbf{4}}$$