**[2.10] CAS square root simplification limitations**

The 89/92+ CAS (computer algebra system) rarely treats the square root operator as identical to raising the argument to the 1/2 power, because, in general, the two operations are not equivalent. For example,

$$x^{\frac{3}{2}} - \sqrt{x^3}$$

does not simplify to zero. However, the expression does simplify to zero if we restrict x, in other words, these expressions

$$x^{\frac{3}{2}} - \sqrt{x^3} \mid x > 0 \qquad \text{or} \qquad x^{\frac{3}{2}} - \sqrt{x^3} \mid x \geq 0$$

both correctly return zero.

If you write programs that manipulate symbolic expressions, you need to consider the domain of the variables. For example, for x < 0,

$$\left(x^{\frac{1}{2}}\right)^3 = -(-x)^{\frac{3}{2}} \cdot i \qquad \text{and} \qquad \left(x^3\right)^{\frac{1}{2}} = \sqrt{-x^3} \cdot i$$

If x = -1, then the first expression gives -i, and the second is i. Both expressions *do not* simplify to x^(3/2), because the identity (x^a)^b = x^(a*b) is not true for non-integer exponents *a* and *b*.

You also need to consider the CAS' behavior for x^n when x = 0. For example:

0^n | n>0 = 0
0^n | n=0 = 1, with the warning *0^0 replaced by 1*
0^n | n<0 = 0^*undef*

*(Credit to Carlos Becker for straightening me out on this)*