ALGEBRA REVIEW

Quadratic Formula
The roots of $ax^2 + bx + c = 0$
(if $a \neq 0$) are:
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Example
The roots of $x^2 + 3x - 1 = 0$ are $x = \frac{-3 \pm \sqrt{13}}{2}$.

Special Factors
$$x^2 - a^2 = (x + a)(x - a)$$
$$x^3 - a^3 = (x - a)(x^2 + ax + a^2)$$
$$x^3 + a^3 = (x + a)(x^2 - ax + a^2)$$

Examples
$$(x^2 - 9) = (x + 3)(x - 3)$$
$$(x^3 - 8) = (x - 2)(x^2 + 2x + 4)$$
$$(x^3 - 4) = (x - \sqrt[3]{4})(x^2 + \sqrt[3]{4}x + \sqrt[3]{16})$$

Exponents and Radicals
$$a^0 = 1, a \neq 0$$
$$\frac{a^x}{a^y} = a^{x-y}$$
$$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}$$
$$\sqrt[n]{a^m} = a^{\frac{m}{n}} = (\sqrt[n]{a})^m$$

$$a^{-x} = \frac{1}{a^x}$$
$$(a^x)^y = a^{xy}$$
$$\sqrt[n]{a} = a^{\frac{1}{n}}$$
$$\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$$

$$a^x a^y = a^{x+y}$$
$$(ab)^x = a^x b^x$$

Algebraic Errors to Avoid
$$\frac{a}{x + b} \neq \frac{a}{x} + \frac{a}{b}$$
To see this error, let $a = b = x = 1$.

$$\sqrt{x^2 + a^2} \neq x + a$$
$$a - b(x - 1) \neq a - bx - b$$
To see this error, let $x = 3$ and $a = 4$.
Remember to distribute the negative sign.
This should be:
$$a - b(x - 1) = a - bx + b$$

$$\frac{x}{a} \neq bx$$
$$\frac{b}{a} \neq \frac{bx}{a}$$
To divide fractions, invert and multiply. This should be:
$$\frac{x/a}{b} = \frac{x}{ab} = \frac{x}{a/b} = \frac{x}{1} = x$$

$$\sqrt{-x^2 + a^2} \neq -\sqrt{x^2 - a^2}$$
We can’t factor a negative sign out of the square root.

$$\frac{a + bx}{a} \neq 1 + bx$$
We can only cancel factors of the entire numerator with factors in the denominator.
This one should be:
$$\frac{a + bx}{a} = \frac{a}{a} + \frac{bx}{a} = 1 + \frac{bx}{a}$$

$$(x^2)^3 \neq x^5$$
The equation should be:
$$(x^2)^3 = x^2 x^2 x^2 = x^6$$

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