1. $\dfrac{3}{x} + \dfrac{x+2}{x^2} = \dfrac{3+x+2}{x+x^2}$

Adding and subtracting fractions requires a common denominator! The correct way to add these:

$\frac{3}{x} + \frac{x+2}{x^2} = \frac{3 \cdot x}{x \cdot x} + \frac{x+2}{x^2} = \frac{3x + x + 2}{x^2} = \frac{4x+2}{x^2}$

($x \cdot x = x^2$)

2. $\sin^{-1} x = \dfrac{1}{\sin x}$

The "-1" exponent on a FUNCTION doesn't indicate a reciprocal. It indicates the inverse function. If you prefer, you can use the notation arcsin x.

3. $\sin(2x+3) = \sin 2x + \sin 3$

No "distributing" trig functions! That's why you had to learn all those angle sum identities, because you can't just apply the function to each term individually. sin (2x+3) can be left just as it is.

4. $(x+3)^2 = x^2 + 9$

You can't just square each term individually! Remember:

$(x+3)^2 = (x+3)(x+3) = x^2 + 6x + 9$

5. $\dfrac{\log_2 x}{\log_2 5} = \log_2 x - \log_2 5$

This is a misapplication of a log rule. The expression on the left can't be rewritten in a particularly useful way. The expression on the right can:

$\log_2 x - \log_2 5 = \log_2 \frac{x}{5}$

6. $\tan\theta = \dfrac{\sin}{\cos}\theta$

Every trig function needs its OWN argument. sin or cos by themselves are meaningless. Correct:

$\tan\theta = \frac{\sin\theta}{\cos\theta}$

7. $e^{x+2} = e^x + e^2$

This is a misapplication of an exponent rule. Correct:

$e^{x+2} = e^x \cdot e^2$

8. $\tan(x^2) = \tan^2 x$

The order of operations is different for the expression on the left versus the one on the right. On the left, x gets squared first. On the right, the tangent function is applied to x first, and THEN the result is squared: $\tan^2 x = (\tan x)^2$

9. $\dfrac{x^2+x+3}{x+4} = \dfrac{x^2+3}{4}$

You can only cancel factors, not terms. Since the x in this case is a term, it can't be simplified away.

10. $\dfrac{\sin x}{\sin y} = \dfrac{x}{y}$

Dividing the top and bottom by "sin" doesn't make sense, because "sin" is a function, not a number. There isn't any helpful simplification to be done to the expression on the left.

11. $e^x e^2 = e^{2x}$

This is another misapplication of exponent rules. Correct:

$e^x e^2 = e^{x+2}$

12. If $\sin x = \dfrac{1}{2}$, then $\sin^{-1} x = 2$.

This is similar to the mistake in question 2. Remember that the exponent isn't indicating a reciprocal relationship when it is on a function.