When trying to simplify trigonometric expressions or prove trigonometric identities, there are usually 2 or 3 different algebraic or trigonometric techniques you could use at every step.

If you simply try any technique that happens to come to mind, you will probably

- spend a lot of time going around in circles,
- generate expressions that get progressively more and more complicated,
- become increasingly frustrated and hopeless,
- lose confidence in your ability to do this type of work, AND
- give up.

However, if you follow certain guidelines and try the various techniques in a specific order, you will find that they make the process more systematic, with a higher probability of success.

GUIDELINES:

- 1. For identities, start with the "harder" side. This is usually the side with addition, subtraction and/or fractions involving trigonometric functions. (Multiplication and division are considered "easier", just like when working with fractions it's easier to multiple and divide fractions than to add or subtract them.). This may also be the side that contains a greater variety of angles or trigonometric functions.
- 2. For identities, make sure you keep in mind what the other side looks like, so you know what trigonometric functions and operations should and should not appear in the final expression.
- 3. Whenever a complex fraction appears, simplify it immediately, before you use it for any purpose.

The discipline of following the techniques in the sequence below will increase the likelihood that 1. you use the most powerful techniques as quickly and as often as possible,

2. you don't make changes that simply lead you in endless circles.

ORDER IN WHICH TO TRY TECHNIQUES:

- 0. Use negative angle, sum/difference of angles, double angle identities, so that as few different angles appear inside the trigonometric functions as possible. (You usually only need to do this step once at the very beginning.)
- 1. Use Pythagorean identities, if the square of a trigonometric function appears.
- 2. Use reciprocal and quotient identities, if 3 or more trigonometric functions appear, or if 2 trigonometric functions appear that are not related by a Pythagorean identity.
- 3. Use algebraic techniques such as
 - a. simplifying complex fractions
 - b. adding/subtracting two fractions into one
 - c. factoring/distributing
 - d. splitting one fraction into two if the numerator involves addition or subtraction
 - e. adding and subtracting the same expression
 - f. multiplying by a fraction with the same numerator and denominator
 - i. to introduce a difference of trigonometric functions from a Pythagorean identity
 - ii. to introduce a numerator or denominator that appears in the final expression

Use technique 0 first (and usually only once).

(*) If technique 1 is useful, use technique 1 once.

If technique 1 is not useful, but technique 2 is useful, use technique 2 once.

If technique 1 and 2 are not useful, but technique 3 is useful, use technique 3 once.

Every time you use any technique <u>once</u>, go right back to (*) trying technique 1 again.

- If you just used technique 2, try technique 1 again before you use technique 2 or 3 again.
- If you just used technique 3, try using technique 1 again before you use technique 2 or 3 again.

If technique 1 doesn't apply, try using technique 2 again before you technique 3 again.